TITLES UNDER EXEMPLAR INSTRUCTIONAL MATERIAL

Basic Skills in Carpentry (Class VI)
Creative Printing (Class VII/VIII)
Leather Work (Class VI/VII/VIII)
Electricity at Work (Classes VI—VIII)
Sheet Metal Work (Class VII/VIII)
Milk Production and Handling (Classes IX—X)
Milk and Milk Products (Classes IX—X)
Woodcraft (Class IX)
General Horticulture (Classes IX—X)
Scooter and Motorcycle (Repair and Maintenance) (Classes IX—X)
Meals for the Family—Volume I (Class IX)
Care of the Household (Classes IX—X)
Introduction to House-wiring (Classes IX—X)
Plant Protection (Classes IX—X)
Repair and Maintenance of Household *Electrical Appliances* (Classes IX—X)
Electronics Technology (Classes IX—X)
Photography (Class IX)
Basic Office Practice (Classes IX—X)
Basic Book-Keeping (Classes IX—X)
Introduction to Plumbing (Classes IX—X)

Exemplar Instructional Material
for
Pre-vocational Course under
Work Experience
on

IR AND MAINTENANCE OF OUSEHOLD ELECTRICAL APPLIANCES

ISTRUCTIONAL-CUM-PRACTICAL MANUAL

Classes IX—X

SACHCHIDANANDA RAY
Project Coordinator

एन सी ई आर टी
NCERT
ाष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

April 1987
Chaitra 1909

P.D. 10 T—YL

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Cover : Leena Chachad

Rs. 10.95

Published at the Publication Department by the Secretary, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110016 and Phototypesetting by Print—Aid Photosetters, Naraina Indl. Area, Phase II, New Delhi and Printed by N.K. Enterprises, 4782/2/23, Darya Gunj, New Delhi 110002.

FOREWORD

The National Council of Educational Research and Training has developed its new framework document for the Ten-Year School titled *National Curriculum for Primary and Secondary Education—A Framework.* This document is a fore-runner of the new National Policy on Education, 1986 which incorporates the basic philosophy of the national curriculum into the policy framework. Both the "Framework" and the policy were developed after a great deal of national debate and deliberations through national and regional seminars and a variety of other modes of interactions and exchange of ideas. These are two historic documents which hold the promise of revolutionising the content and process of school education throughout the country. The programme of Action document which provides an elaboration of NPE'86 has recommended the development of curricular guidelines and exemplar curricular and instructional materials. In order to provide details in respect of various ideas in the two documents it was felt necessary to develop detailed curricular guidelines, exemplar curricular frames and instructional materials in various areas. The policy envisages integration of productive work with education and status that, "Work Experience, viewed as purposive and meaningful manual work, organised as an integral part of the learning process and resulting in either goods or services useful to the community, is considered as essential component at all stages of education, to be provided through well-structured and graded programmes. It would comprise activities in accord with the interests, abilities and needs of students, the level of skills and knowledge to be upgraded with the stages of education. This experience would be helpful on his entry into the workforce. Pre-vocational programmes provided at the lower secondary stage will also facilitate the choice of the vocational courses at the higher secondary stage".

In Pursuance of this policy and the programme of Action and to maintain continuity with the curricular guidelines and syllabi developed by NCERT a set of exemplar instructional materials have been developed for the use in schools. The present title Repair and Maintenance of Household Electrical Appliances is a part of this series. It has been developed by the Department of Vocationalization of Education by involving experts in the

subject area, teachers and curriculum experts. I am grateful to all those who have contributed to this work both within and outside the Council.

I hope the students and teachers using this material will find it useful in performing the desired work experience activities. Further, in view of the fact that it is one in the series of exemplar instructional materials, it is also hoped that those concerned with the development of the variety of instructional materials will find it of great help in developing similar materials to suit the needs of students in widely varying situations in the country.

New Delhi

January 1987

P.L. MALHOTRA
Director
National Council of Educational Research and Training

PREFACE

The NCERT Document, *National Curriculum for Primary and Secondary Education—A Framework* and the National Policy on Education – 1986 have accepted the concept of Work Experience to be included as an integral component of education at all stages of education, particularly the school stage. In pursuance of the conceptual framework presented in these documents the Department of Vocationalization of Education had developed guidelines for curriculum development and implementation and a set of exemplar pre-vocational courses under Work Experience. The guidelines cover all stages of school education while exemplar courses have been developed only for the upper primary and secondary stages of education. The two documents, through intelligible independently of each other, constitute two sister volumes dealing with the same subject. The Department has gone further to develop a set of twenty exemplar instructional materials in the first instance which cover major areas of Work Experience in School Education. The present title was developed in a workshop held at NCERT, New Delhi from 15 to 19 September, 1986 in which several subject experts, teachers and curriculum specialists participated (list given elsewhere). The manuscript was further refined by Shri S. Ray, the Project Coordinator concerned with this title and brought in the final form for publication. Kumari Ritu Verma was overall coordinator for the workshops in which the materials were developed and was helpful in keeping track of the work during the course of their publication. I wish to place on record my grateful appreciation for the work done by all concerned in respect of this publication.

It is expected that the students and teachers as well as the curriculum developers who use this publication may find it useful. The Department will be happy to receive their comments for further improvement of the material.

New Delhi
January 1987

ARUN K. MISHRA
Professor and Head
Department of Vocationalization of Education

ACKNOWLEDGEMENT

Exemplar instructional material on "Repair and Maintenance of Household Electrical Appliances" as a pre-vocational course under Work Experience for Classes IX and X was developed in a workshop conducted by the NCERT at New Delhi from 15 to 19 September 1986. The following experts participated in the workshop for the development of the material :

1. Shri Sachchidananda Ray
2. Shri Prabhakar D. Patil
3. Shri R.P. Chaurishiya
4. Shri D.N. Nagaraju
5. Shri P.K. Bansal
6. Shri Bhupinder Kapur

Their participation as contributors is gratefully acknowledged.

CONTENTS

INTRODUCTION

The importance of Work Experience has been highlighted in the National Policy of Education 1986. It has emphasised that the work experience should be in the form of well-structured graded programme comprising activities to cater to the needs of the students. The level of knowledge and skills should be upgraded with the advancement in stages of education. Pre-Vocational Courses have also been recommended to help the students in entering the world of work and to facilitate the choice of Vocational Courses at the higher secondary stages.

Household electrical appliances like heaters, electric iron, mixers, geysers and fans are being extensively used in urban and rural areas for comfort. These appliances are subjected to wear and tear due to normal use. Hence, there is a scope for wage and self-employment in this area. Considering the prospect of employment "Repair and Maintenance of Household Electrical Appliances" is recommended as a pre-vocational course under work experience for Classes IX and X.

Pre-vocational course of "Repair and Maintenance of Household Electrical Appliances" has been developed by NCERT through a workshop. Dismantling, testing, reassembling and proper working of household electrical appliances have been included in this pre-vocational course so as to make it relevant to the needs, interests and abilities of the students.

This book contains 31 exemplar activities which can be conducted under average urban school conditions. These activities can also be conducted in rural schools if they are electrified and procure the appliances. Related information relevant to the activity precedes the procedural part in each activity and thus, enlightens the students about the fundamentals of the activity they are going to do. The instructions for doing each activity are given step-by-step, leading to the successful completion of the activity.

Activities illustrated in this book are self-explanatory.

The students should be able to do most of the activities independently. But the teacher should provide necessay information and knowledge and demonstrate part of the activities for better learning by the students. By the end of Class X, the students will be able to carry out minor repair, routine testing and maintenance of household electrical appliances. This course will also prepare students for a related vocational course at plus two stage.

Activity No. 1

Time Required: 2 Hours

FUNDAMENTALS OF ELECTRICITY

OBJECTIVES

(i) To understand that electricity is a form of energy.
(ii) To recognise that electrical energy can be obtained from other forms of energy.
(iii) To identify that electrical energy can be connected to other forms of energy.
(iv) To recognise the several household appliances working on electricity.
(v) To classify AC and DC supply.

RELATED INFORMATION

We are living in the modern world and make use of several appliances in our daily life. Most of these appliances work on electricity. We should have some knowledge about electricity in order to use the appliances safely.

What is Electricity ?

Electricity is a form of energy and it has the capacity to do work like other forms of energy, e.g., heat, sound, mechanical, light. Electrical energy is used for the benefit of man.

Electric torch, electric fan, room heater, light, electric iron, calling bell are some of the common household appliances.

We get electricity by generating it from other power sources. Electricity can be generated by using hydel, thermal, wind and nuclear power. In these cases we are only converting one or the other form of energy into electrical

energy. Electrical energy cannot be created.

Electrical household appliances consume electricity and give us comfort. Here again we are converting electrical energy into another form of energy.

A heater converts electricity into heat, a lamp converts electricity into light and in a electric clock electricity is converted into mechanical energy. In order to make life comfortable, man is making use of several appliances in his daily life. With the advancement of sciences and technology, we are

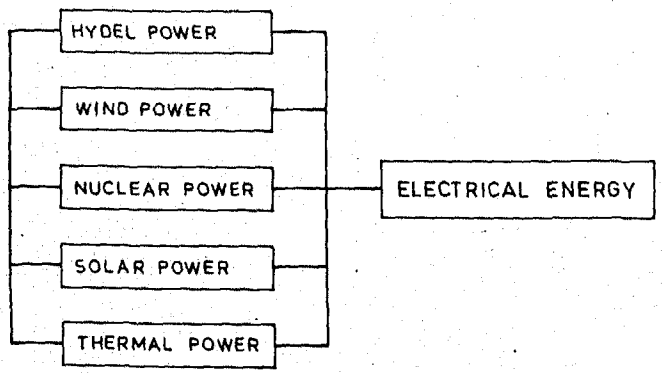


Fig. 1.1 Sources of electrical energy

inventing more gadgets and the consumption of electricity is on the increase. Owing to limited resources, there is shortage of electrical power in our country. We must also see that we are not wasting electricity unnecessarily.

As observed earlier the list of electrical appliances is becoming endless. However we can list the following as common household appliances:

(i) Table lamp
(ii) Electric buzzer/chyme
(iii) Electric iron
(iv) Room heater
(v) Electric kettle
(vi) Flourescent tube
(vii) Electric mixer
(viii) Electric toaster
(ix) Electric fan
(x) Electric hot plate.

Modern houses may afford to have geyser, electric clock, washing machine, hair dryer, etc.

Most of the appliances carry a name plate which indicates AC or DC supply to be used.

AC and DC supply : By AC we mean alternating current. Most of the domestic lighting and heating systems make use of alternating current. We have some appliances which work on DC. Before connecting the supply we must make

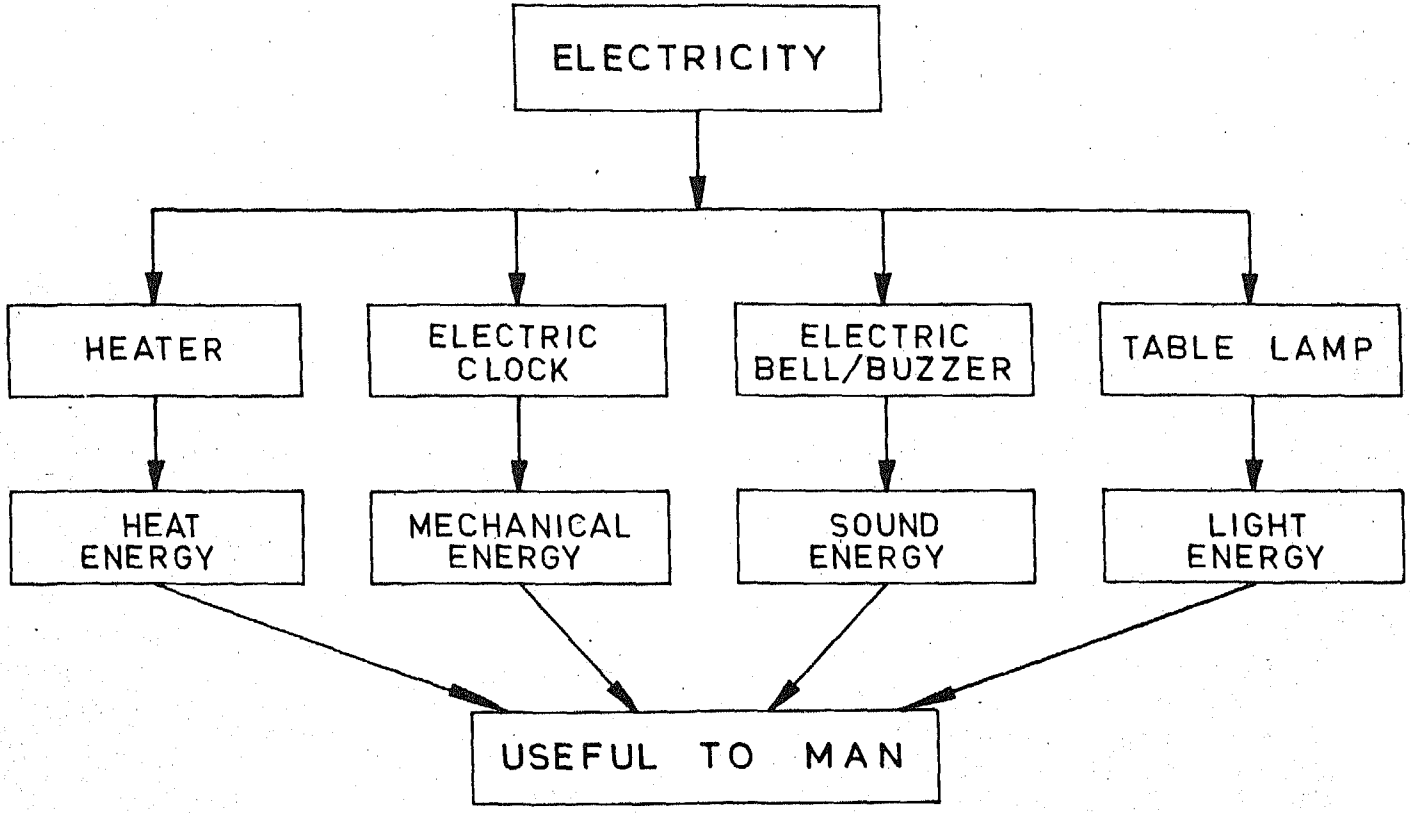


Fig. 1.2 Utilization of electrical energy

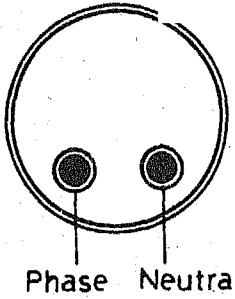


Fig.1.3 A.C. Supply 230 Volts

sure whether the appliance can work on AC only or DC only. Sometimes an appliance may work both on AC and DC. In an AC supply the terminals are identified as phase and neutral. The phase wire can be identified by placing a neon tester on it. The supply voltage of AC is 230 volts in our houses.

In DC supply the terminals are identified as positive and negative. The appliance working on DC is also marked for its polarity. The positive from the supply must be

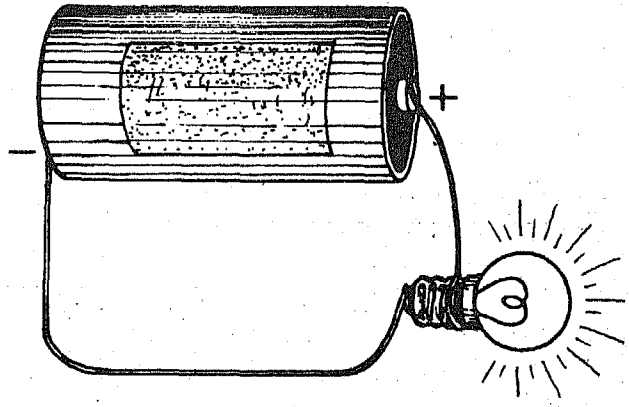


Fig. 1.4 D.C. Supply 1.5 Volt

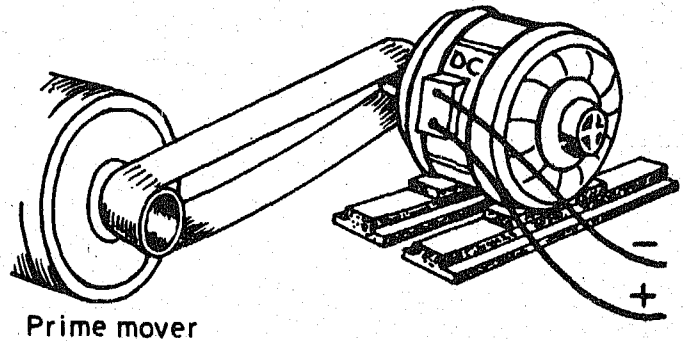


Fig.1.5 D.C. Generator

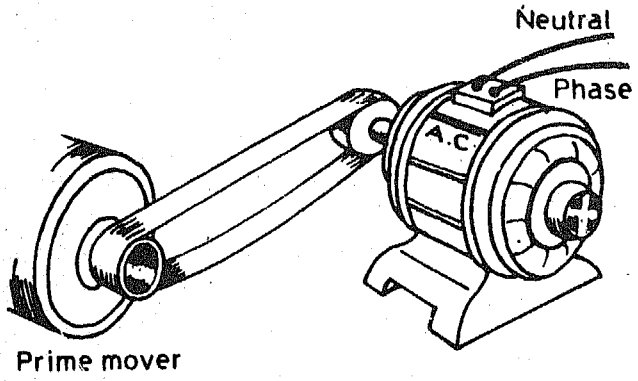


Fig. 1.6 A.C. Generator

connected to the positive terminal of the appliance. If we interchange the connection, it may damage the appliance. The AC supply is usually given by electricity board and DC source is available in DC generator, batteries and cells.

Activity No. 2 **Time Required: 2 Hours**

CONCEPT OF VOLTAGE,CURRENT, RESISTANCE, POWER AND ENERGY

OBJECTIVES

(i) To Understand the concept of current, voltage, resistance, power and energy.
(ii) To define the terms like current, voltage, resistance.
(iii) To relate current voltage and resistance.

RELATED INFORMATION

We use the terms like voltage and current when we talk about electricity.But it is essential to understand the concept behind these terms in order to use them in correct sense. When we use electrical gadgets, it is essential to know their input in terms of voltage and current. The capacity of the appliances is understood, by the current it can draw and the voltage it can withstand. We must know these quantities in order to use the gadgets safely.

Current: The flow of electric charges is known as current. It is measured in amperes. It is denoted by letter 'I'. The instrument which measures current is known as ammeter. Elecrical appliances draw current depending on their capacity. (0.1 amp, 5 amps, 15 amps, etc.)

Voltage: Electric charges are forced to move from point to point due to potential difference. This force is known as Electromotive Force (EMF). It is denoted by the letter 'V' and is measured by voltmeter. Voltage is 230 V for domestic supply and 1.5V in a dry cell.

Resistance: While charges move in a metal wire there is some opposition to this movement. This opposition is

known as resistance. Resistance is measured by ohm-meter in ohms. It is denoted by 'R'.

$$I = \frac{V}{R}$$

$$V = IR$$

$$R = \frac{V}{I}$$

Power:It is measured in watts and instrument measuring electric power is watt meter. The electric power is calculated as a product of voltage and current. 'W' stands for watts. For example, lamps are available in 25W, 40W and 60W, etc.

$$W = VI \text{ Watts}$$

Energy:It is measured in Kilo Watt Hour. (1 kilo watt hour= 1000 watt hour). A meter which measures energy consumption is known as energy-meter or KWH meter. The elecricity board provides meters in every house to record the consumption of electrical energy. KWH is also expressed as Unit of power. Energy is calculated by the equations:

Energy=WT KWH

Energy=VIT KWH

APPLICATION

We can observe the details given on electric appliances like lamps, electric iron, heater, fan etc. to know their capacity.

Activity No. 3 **Time Required: 2 Hours**

FAMILIARIZATION WITH ELECTRICIAN'S COMMON HAND TOOLS

OBJECTIVES

(i) To identify common tools used for repair of household electrical appliances.

(ii) To aquaint with the uses of hand tools.

(iii) To understand the need for maintenance of tools.

(iv) To select proper tools for working.

RELATED INFORMATION

Good tools when used properly make work easy and neat. Tools are used by workers as an aid. An electrician also uses tools while working on electricity. These are known as electrician's tools. A knowledge of tools and their uses help us in selecting the proper tool for a given work. Tools need care and maintenance for ensuring a long life.

Electrician's Knife: It is made up of good steel and is foldable. It is used for removing insulation and cleaning wires.

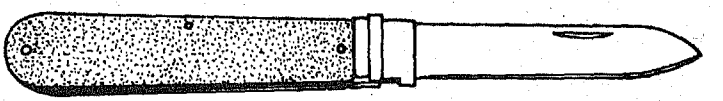


Fig. 3.1 Electrician's Knife

Electrician's Pliers: It is useful for cutting, twisting and pulling wires. Cutting pliers are specified in lengths and available in the range of 15 to 30 cms. The handles of the pliers are provided with insulation jacket to provide safety from electric shock.

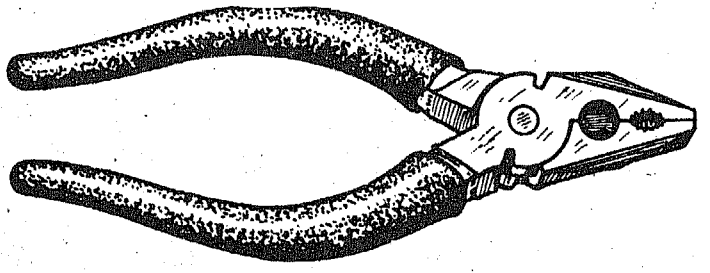


Fig. 3.2 Electrician's Pliers 15 cm

Nose Pliers It is used for holding nuts and screws in such places where space is limited. The jaws of pliers are made long for the above purpose.

Wire Cutter: It consists of two sharp edges by which we can cut the wire ends easily.

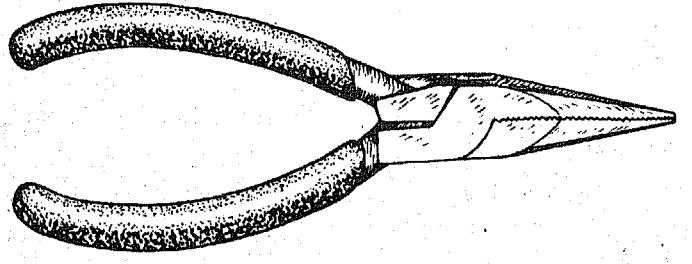


Fig. 3.3 Insulated Nose Pliers 10 cm

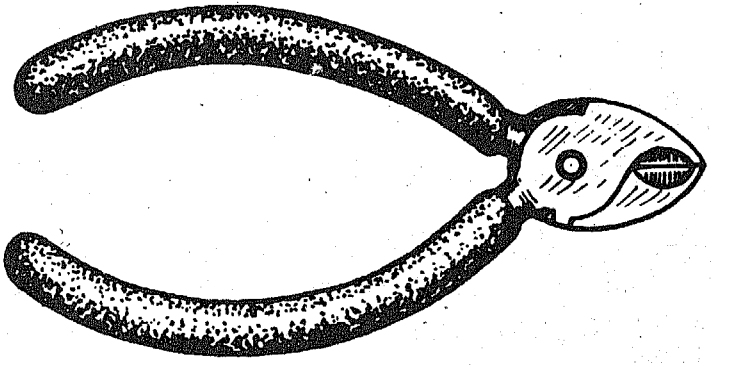


Fig. 3.4 Wire Cutter 15 cm

Screw Driver: It is provided with an insulating handle. It is used for fixing screws and are available in various sizes.

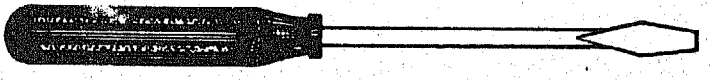


Fig. 3.5 Screw Driver 15 cm

Connector Screw Driver: It is a small screw driver. It is used for fixing the tiny screws on the holders, plug pins and sockets.

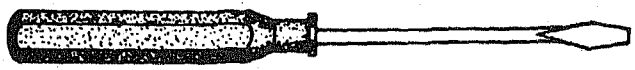


Fig. 3.6 Connector Screw Driver 10 cm

Neon Tester: It is used for testing the supply. The phase wire can be identified by the flow in the tester when the tip of the tester is placed on it. Tester is provided with a screw driver but this should be used with care.

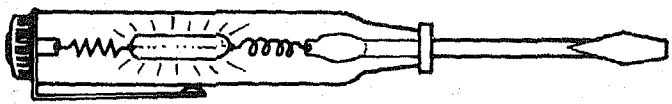


Fig. 3.7 Neon Tester

Adjustable Screw Spanner: It is used for loosening and tightening nuts and bolts in electrical appliances. The spanner could be adjusted to suit the width of the nut or bolt head.

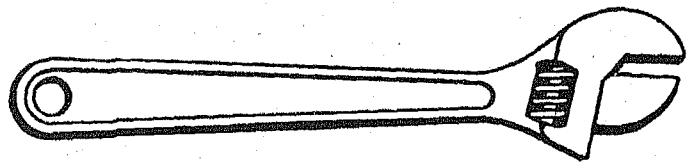


Fig. 3.8 Adjustable Screw Spanner 15 cm

The tools mentioned above are simple and easy to operate. However, we have to take care for the maintenance of these tools. A tool kit or a tool chest may be used for keeping the tools after work. Tools should not be thrown here and there.

Wrong usage of tools also results in damage to tools and injury to the operator. Proper selection of tools will ensure safety for the operator.

Note: The use of tools should be taught by demonstration method. The correct use of tools should be shown by the teacher. The teacher should demonstrate the use of tools in actual work situations. The teacher should insist that the students clean the tools after work and keep them in proper place.

Activity No: 4 **Time Required: 2 Hours**

FAMILIARIZATION WITH SAFE WORKING PROCEDURE

OBJECTIVES

(i) To recognise the importance of safety.
(ii) To analyse causes for accidents.
(iii) To identify safe procedure for working.
(iv) To apply safe procedure in actual working situations.
(v) To generalise the safe working procedure.

RELATED INFORMATION

Electricity is highly dangerous to work on as electric shock is deadly. More over it is invisible and even little negligence may cause accidents. But we need not be in panic if we follow certain procedures to ensure safety. The procedures are known as safety procedures.

While working, we have to consider the personal safety of the operator or mechanic. But in addition to this we must consider the safety of others, safety for tools and equipment also. It is essential that we do not damage tools and cause accidents which may disrupt the workshop itself.

It is not enough to know about safety procedures. We should be able to apply these in work situations and make safety as a habit while working. We can list the safety procedures in terms of what we should do and what we should not do. These procedures are as follows:

(i) Never touch a current carrying wire or conductor.
(ii) Never pull out a flexible cable while removing the plug from the mains.

(iii) Switch off the supply while checking any electrical appliance.
(iv) Never play with tools.
(v) Handle tools carefully and be alert while working.
(vi) Never switch on supply unless you are sure about working of an appliance.
(vii) Ensure that proper earthing is provided for the appliance.
(viii) Seek guidance of your teacher in case of any doubt and do not try to experiment yourself.
(ix) Report any damage/breakdown to your teacher immediately.
(x) Switch off the electrical supply and appliances before you leave the shop and disconnect them from the mains.
(xi) Read the details on the appliance before connecting it to the supply.

APPLICATION

The principles of safety could be generalised and adopted to various work situations. Even while working at home, office and elsewhere we should not forget to adopt safety procedures.

Note: Safety is as essential as discipline in a workshop. The teacher should observe the students at work and guide them for safety. The teacher should ask the students to prepare charts and posters dipicting safety. The safety slogans and posters should be prominently displayed in the workshop. The students may be guided to work incorporating the safety measures. Since the students imitate the teacher, he should demonstrate safe working procedure only.

Activity No: 5

Time Required: 3 Hours

ELECTRIC SHOCK TREATMENT PRACTICE

OBJECTIVES

(i) To identify the steps to be observed in shock treatment.

(ii) To apply the shock treatment procedure in a practical situation.

RELATED INFORMATION

Electric supply is widely used in our daily life. AC supply is operated at 230 volts and most of the domestic appliances work at this voltage.

Sometimes due to sheer negligence or haste we may come in contact with electricity. In such a case one will be subjected to shock and this shock could be dangerous. One should not play with electricity and should be cautious while working on electrical appliances.

Sometimes due to loose connections, short circuits and faulty connections one may receive electric shock. We should know to treat the shock victim with first aid till medical assistance is available. When a person receives electric shock he may fall and become unconcious. In such cases we must break the contact between the person and the supply. We should not touch the victim or try to push him with bare hands. The victim may be pushed by using a dry wooden pole. Rubber gloves if available could be used. Switch off the main if it is nearby and accessible. Inspect the victim. If he is not unconcious, give him some warm drink like coffee/tea. Make him feel comfortable.

If the victim has breathing difficulty after the shock,

give artificial respiration at once by following the steps of artificial respiration.

PROCEDURE

Position 1: Place the victim's face down with his arms folded one over other and head resting on them. Kneel on one or both knees at the victims back beyond the line of armpits with your finger spread outwords and thumbs touching each other.

Fig. 5.1 Position No. 1

Position 2: As you count one, two, three, rock forward keeping arms straight until they are nearly vertical, thus steadily pressing victims back. This completes expiration.

Position 3: As you proceed to count four, rock backwards, relcasing pressure and slide your hand downwards along the victim's arms and grasp his upper arm just above elbow. Continue to rock backwards.

Position 4: As you rock back counting five, six, seven, raise and pull the victim's arms towards you until you feel tension in his shoulders. This expands his chest and results in inspiration.

As you count eight, lower the victim's arms and move

Fig.5.2 Position No. 2

Fig.5.3 Position No. 3

your hands up for the initial position. Repeat the above cycle 12 times in a minute when the victim starts breathing. Synchronise your actions until he breaths strongly. Then stop.

Sometimes artificial respiration should be continued for four hours. In such a case a standby operator is necessary to carry out the artificial respiration without changing the rhythm.

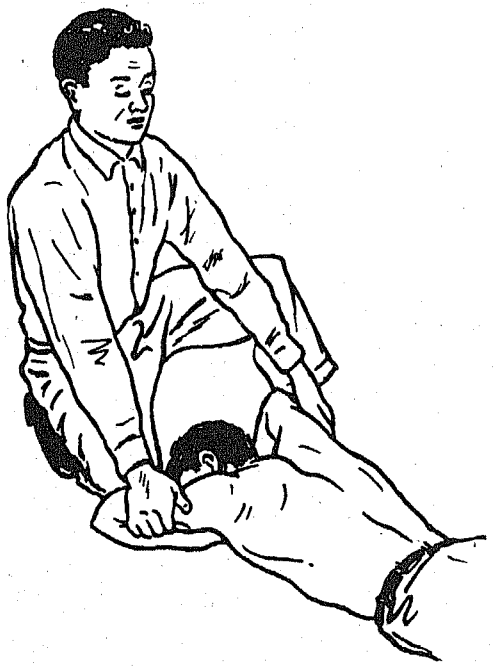


Fig. 5.4 Position No. 4

A brief return of respiration is not a sign of full recovery. The victim may stop breathing after this temporary recovery. Therefore we must make sure that the victim's respiration is fully restored before stopping.

Never give unconscious man anything to drink. It may choke him.

HEART MASSAGE METHOD RECOMMENDED BY RED CROSS

Check for pulse: The easiest place to detect it is not in the wrist but in the throat on either side of the wind pipe near the collarbone. If no pulse is apparent start walking at once. Don't waste seconds in going for equipment for help. For the great peril any heart or breathing arrest is Anoxia i.e. lack of sufficient oxygen in blood to feed the brain. The brain is the most sensitive tissue of the body and the result of oxygen starvation becomes irreversible within a few minutes. A victim who survives belated treatment may suffer an extensive brain damage.

Lay the patient on a smooth solid surface such as floor and not a bed or couch as they are too flexible.

Tilt the head far back.

Kneel so that you can use your weight in applying

pressure. Place the palm of your right hand on the breast bone and not on the ribs.

Place your left hand on the top of the right and press vertically downwards firmly to depress the breast bone, one to one-and-a-quarter inches (with a child use relatively little pressure). The chest of an adult is resistant when he is concious but surprisingly flexible when he is unconscious.

Release the pressure immediately, lifting the hands slightly. Then repeat in about 60—80 thrusts a minute approximately.

The patient should be taken to hospital as early as possible. Even if the normal heart beat and respirations are resumed, the patient needs professional care.

Continue till you get professional aid to take over the patient. If possible mouth to mouth respiration may be continued.

Note to the Teacher: The teacher should demonstrate the artificial respiration method using students to represent various positions. Charts of respirations should be made use for instruction. The cooperation of physical education teacher or Scout Masters, guide captains and NCC officers in the school may be sought to carry out the first aid instruction.

Activity No. 6 **Time Required: 4 Hours**

FAMILIARIZATION WITH COMMON MEASURING INSTRUMENTS

OBJECTIVES

(i) To identify common measuring instruments for measurement of electrical quantities.

(ii) To learn connection of different common measuring instruments in a circuit.

RELATED INFORMATION

Electrical quantities such as voltage, current, resistance and other quantities can be accurately measured with instruments called METERS. Although we cannot see electricity, the meter is designed to react to these electrical quantities and we can read this reaction on the calibarated scale of meters.

In electrical measuring instruments, there is mechanical movement of pointer. Measuring instruments usually consist of parts, such as fixed permanent magnets, moving coils and pointer, etc.

The voltmeter, ammeter and AVO meters are the three most widely used meters. These meters are available for various ranges. Meter used to measure resistance, voltage and current is known as Multimeter or AVO meter. All measuring instruments are very delicate. They must be used correctly and with extreme care. The improper use of measuring instruments, even though only momentarily, can cause severe damage to them.

Some of the symbols of instruments for its proper and

correct use are given in Figure 6.1. Ammeter, voltmeter,

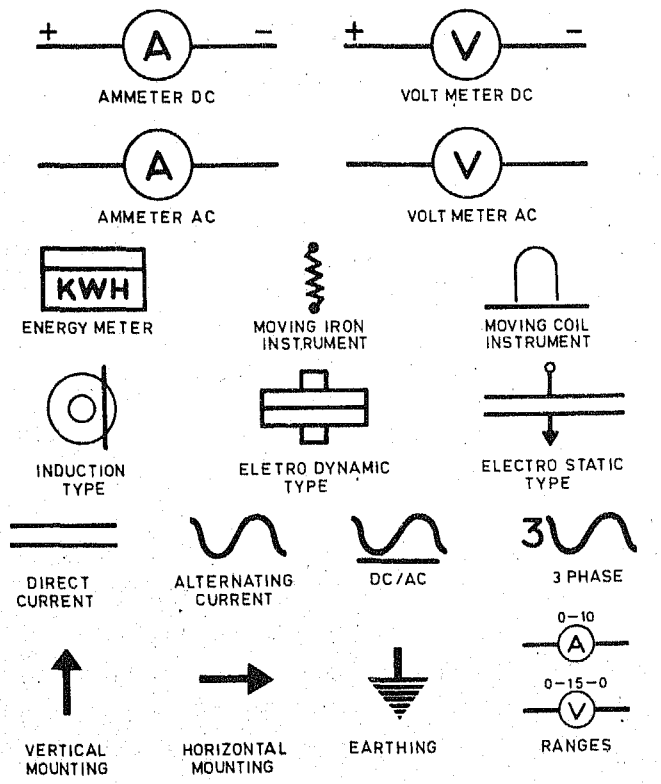


Fig.6.1 Lables on Measuring Instrument

multimeter and energy meter are generally used for measuring electrical quantities.

AMMETER AND ITS CONNECTION

Ammeter is an instrument which is used for measuring current in a circuit. There is no effect of resistance on the circuit with addition of ammeter in series of circuit as the ammeter has negligible resistance. There are two types of ammeters, one for DC current and the other for DC and AC current measurement. The DC current measuring instrument is polarised meter. Hence to measure current in DC circuit, connect positive terminal of meter to the positive terminal of circuit and negative terminal of meter to

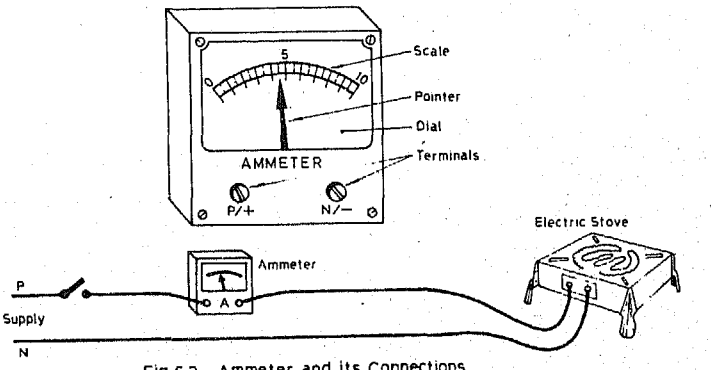


Fig.6.2 Ammeter and its Connections

negative terminal of circuit. In case of connecting AC ammeter, terminals of meter can be connected on either side of circuit alternatively. Connect the ammeter in series in the circuit as shown in Figure 6.2. Ammeters are available for measuring milliamperes and higher ranges.

VOLTMETER AND ITS CONNECTION

Voltmeter is an instrument which is used for measuring voltage of a supply. It is always connected in parallel in a circuit. It has very high resistance. The unit of measurement is VOLT. There are two types of voltmeters, one for DC voltage and the other for AC and DC voltage. For direct current voltage measurement, connect positive terminal of voltmeter to positive terminal of circuit and negative terminal of voltmeter to negative terminal of circuit. For measuring AC voltage, meter can be connected to either sides of an alternating current circuit as shown in Figure 6.3. Before connecting meter, select proper range of meter. Voltmeters are available for reading millivolts, 0 to 100 V, 0 to 300 Volts, 0 to 600 Volts, etc.

MULTIMETER

It is a very useful meter. It has special use in electronics. It is used for measuring current, voltage and resistance.

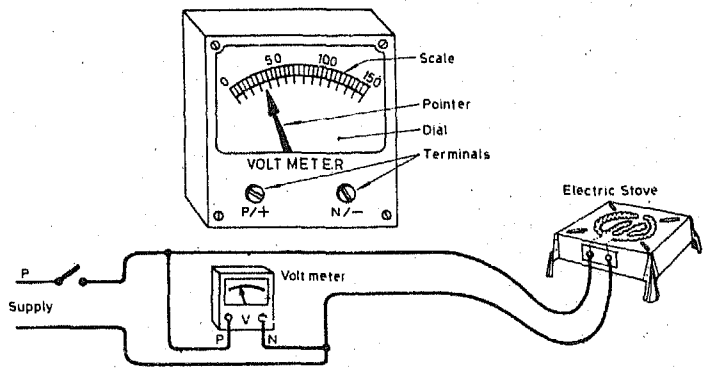


Fig.6.3 Volt meter and its Connections

It is a very delicate instrument. The range and AC/DC arrangements and proper connection are very important. There is a selector switch for AC/DC voltage selection, for DC current measurement and for resistance measurement. The zero adjustment is done before every reading by shorting the testing leads of multimeter. Before connecting for a test it is preferable to have a higher range selection and then accurate reading is taken by selecting desired range.

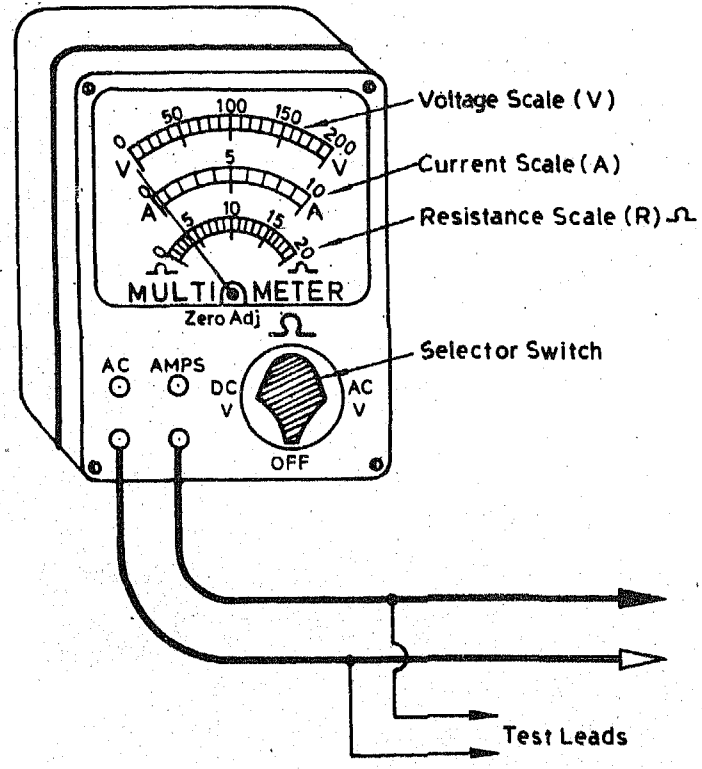


Fig.6.4 Multimeter or Avometer

ENERGY METER

An energy meter is an instrument used for recording the energy consumed by a consumer in the form of 'UNIT' or 'KWH'. It is also known as Kilo Watt Hour Meter. One kilo watt hour power means a thousand watts of power have been consumed in one hour. It is usually fixed in main supply lines of supply company at domestic installation. Usually the meter is sealed by supply company. The old dial type of meters have now been replaced by new

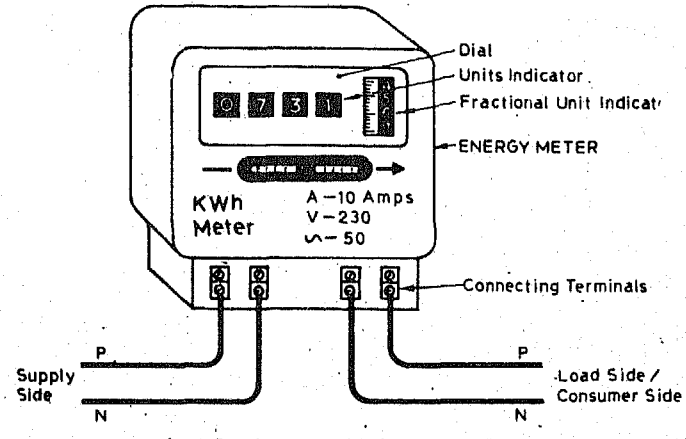


Fig.6.5 Energy Meter

cyclometer type energy meters. The new cyclo type energy meter is a direct reading meter, which shows the total number of kilo watt hours of electric power consumed. In this type of meter, first to fifth position numbers from the left are for units and extreme right number indicates fraction of a unit. The total units consumed over a certain period can be calculated from present reading and previous reading in KWH Units. The difference between previous and present reading will give the KWH of power consumed. Connection of energy meters are done in domestic installation by electricity supply company as shown in Figure 6.5.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

(i) Insulated Combination Pliers 15 cm : one
(ii)Screw driver 15 cm : one
(iii) Electrician's knife : one

EQUIPMENT

(i) Ammeter 0 to 30 Ampere AC/DC : one

(ii) Voltmeter 0 to 600 volt AC/DC one
(iii) Multimeter (AVO) one
(iv) Energy meter 20 Amps, 250 V AC, 50Hz : one

MATERIALS

(i) AC source 230 V, 30 Amps : one
(ii) 40/0076 flexible wire : 4 meters
(iii) Adopter 15 Amps : one
(iv) Electric Heater 230 V, 1 KW : one

Note : The teacher should demonstrate before the students the connection of meters in actual circuit as shown in the diagrams.

PRECAUTIONS

(i) Connect ammeter always in series connection.
(ii) Connect voltmeter always across the supply.
(iii) Take reading perpendicular to the needle to avoide parallactic error.
(iv) Check zero errors of all instruments before they are used.
(v) In DC measurements check polarities.

(vi) Select higher range for measurement initially and later select required range for accuracy.

(vii) Select proper rated meter for measurement of electric quantities.

APPLICATIONS

(i) Ammeter is used for measuring AC/DC current.

(ii) Voltmeter is used for measuring AC/DC voltage.

(iii) Multimeters are used for measuring current, voltage, and resistance. This instrument is extensively used in electronics.

(iv) Energy meters are used in domestic installations to note power consumption.

Activity No. 7 **Time Required: 2 Hours**

FAMILIARIZATION WITH WIRES AND CABLES

OBJECTIVE

To acquaint the students with different types of wires and cables.

RELATED INFORMATION

Wires and cables are used to carry electrical energy from one place to another at different voltages and currents. It is necessary to select correct size and proper type of wire or cable for the specific job. Wire or conductor has mainly two parts, conductor and insulator. Conducting part is usually made up of aluminium or copper. Insulating part is generally made up of rubber or Poly Vinyle Chloride (PVC).

Wire is a piece of insulated or uninsulated circular conductor uniform in diameter. Cable is a length of one or more than one insulated conductors which are laid up together. Cables are known as single core, twin core or three core accordingly as there are one, two or three conductors. Copper though very good conductor is sparingly used as it is costly. In contrast aluminium having its conductivity 60% as that of copper are generally used because of its cheapness and light weight. The wires used for ordinary wiring purposes may be solid, or single conductor, but when the wires are required for more flexibility these are stranded. The number of conductors stranded together depends upon the current-carrying capacity of the wire. The size of each conductor is found by

standard wire gauge (SWG) which gives diameter in millimetre and language number. In common 'Gauge of trade, 'Guage Number' is always referred to. The gauge number ranges from 0 to 36. The zero has got the largest diameter and 36 is the smallest.

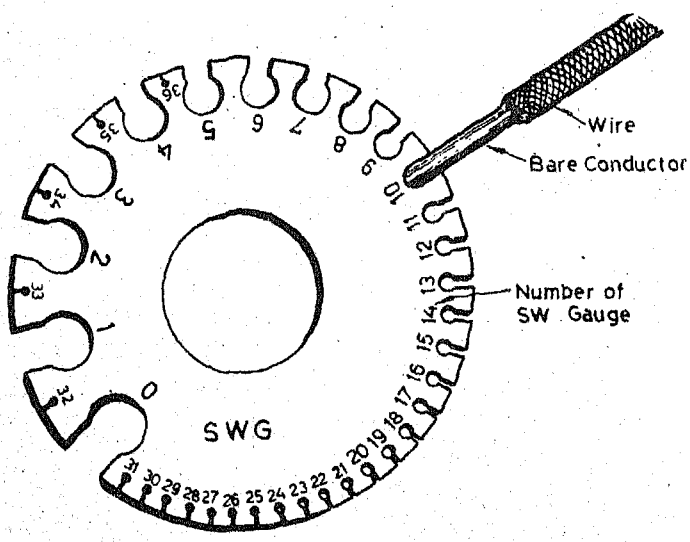


Fig.7.1 Standard Wire Gauge

After the adoption of meteric system in India the size of wires are being usually denoted by cross sectional area in square millimeter such as 1.5 sq. mm or 2.5 sp. mm and 4 sq.mm.

The wires used for house wiring may be single solid conductors but when the wires are required for greater flexibility, such as pendent lamp, wires of single conductors are not suitable. Flexible wires have number of wires of diameter 0.0076 inch or 0.1930 mm (36 SWG) stranded together. The number of stranded conductors together depends upon the current-carrying capacity of the wire. For example, a flexible wire of 40/0.0076 has a current-carrying capacity of 7 amperes and has 40 conductors of 36 gauge stranded together to give a cross sectional area of 1.171 sq. mm.

TYPES OF WIRES

The wires used for electrical installation can be divided into the following categories:

Lead alloy sheathed wires.
Tough rubber sheathed (TRS) or cab tyre sheathed (CTS) wires.
Weather proof Wires.
Flexible wires.

Poly Vinyle Chloride (PVC) wires.
Vulcanised Indian Rubber (VIR) wires.

LEAD SHEATHED WIRES

Such wires have outer sheath of lead or lead alloy on insulated wires. These are used for the weather, where moisture is available such as snow fall areas. For earthing purpose, lead sheath or separate wire enclosed in the sheath is used to avoid danger from leakage. The covering of lead sheath is used for mechanical protection.

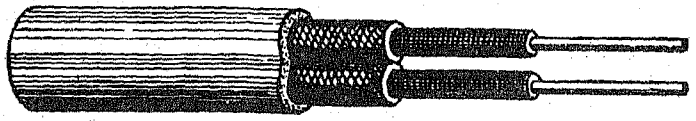


Fig.7.2 Lead Alloy Sheathed Wire

TOUGH RUBBER SHEATHED (TRS) OR CAB TYRE SHEATHED (CTS) WIRES

The ordinary wire is provided with rubber insulation which is not water resistant, but the T.R.S. wires are provided with tough rubber compound and can stand long exposure to moisture and can be used in wet climate. These are costlier wires.

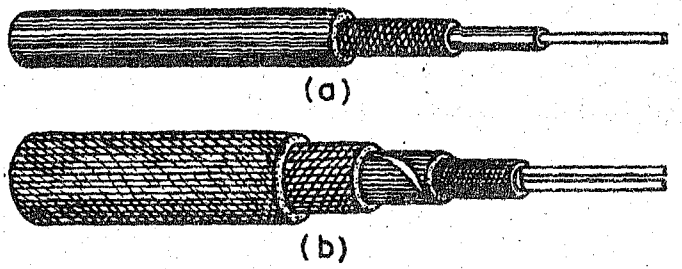


Fig.7.3 Tough Rubber Sheathed (T.R.S.) or Cab Tyre Sheathed (C.T.S.) Wire

WEATHER PROOF WIRES

These are used for outdoor connection such as service lines. The conductors are first insulated with rubber then braided with cotton thread. The braiding material is dipped in water proof compound.

Fig.7.4 Weather Proof Wire

FLEXIBLE WIRES

These wires are used for household appliances such as heaters, irons, etc. These wires usually consist of two separately insulated flexible stranded conductors. These wires are further classified as (a) Twin silk cord (b) Twin rubber insulated cord (c) Twin twisted cotton braided, flexible wires (d) Twin TRS flexible wires.

Twin silk cord consists of two core consisting of number of fine copper conductors stranded together. Each conductor is covered with silk insulation as shown in figure 7.5.

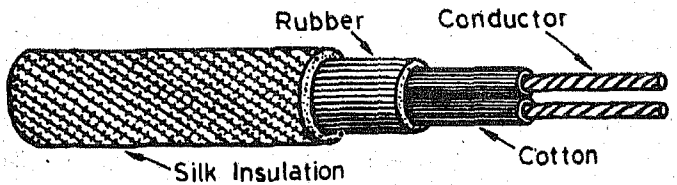


Fig.7.5 Twin Core Flexible Wire

Twin rubber insulated cord is similar to twin silk wire and consists of two stranded conductors covered with cotton thread and embedded in solid rubber insulation. The rubber used for the purpose is of good quality.

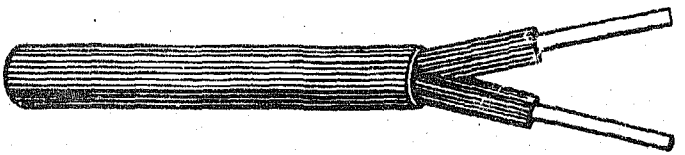


Fig.7.6 Twin Rubber Insulated Wire.

Twin twisted cotton braided flexible wires are insulated like silk flexible cord and are followed up with a layer of rubber insulation and then braided with cotton. Then two of these conductors are twisted together as shown in Fig. 7.7.

Fig.7.7 Twin Rubber Insulated Cord

The TRS flexible wire consists of two or more insulated conductors twisted together as in case of twin twisted flexible wire. The open space in between the twisted conductors is filled up with cotton or jute threads, so as to form round assembly. Over this assembly is provided a loose cotton braid and then a final layer of high grade tough

rubber as shown in figure 7.8.

Fig. 7.8 Twin T.R.S. Flexible Wire

PVC INSULATED WIRES

These wires are available in 250/440 and 650/1100 volt grades and are used in concealed wiring system. In this type of wires, conductor is insulated with PVC insulation. Since PVC is harder than rubber, it does not require cotton taping and braiding over PVC insulation for mechanical and moisture protection.

TYPES OF CABLES

Power from generating station can be transmitted either by overhead lines or cables placed underground. The cables are usually classified according to the voltage for which they are manufactured.

Low Tension (LT) Cables for 1000 Volts.
High Tension (HT) Cables for upto 11000 Volts.
Super Tension (ST) Cables for upto 22/33 KV.

Extra High Tension (EHT) Cables from 33 KV to 66 KV.
Oil filled and Gas Pressure Cables from 66 KV to 132 KV.

GENERAL CONSTRUCTION

Core: All cables have a central core, or a number of cores of stranded copper conductor having good conductivity. In general there are one, two, three or four cores.

Insulation: Different insulations used to insulate the conductors are paper, varnish, cambric and vulcanized bitumen for low voltage. Mostly impregnated paper is used as an excellent insulating material. For low voltage cables, petroleum jelly is applied between the layers of cambric tape to prevent damage to insulation due to friction when the cables are handled.

Metalic Sheath: It is provided over the insulation so as to prevent entry of moisture in the insulating material.

Bedding: It consists of paper tape compounded with fiberous material. The purpose of bedding is to protect metallic sheath from mechanical damage.

Armouring: It is provided to avoid mechanical injury to the cable. It consists of one or two layers of galvanised steel wires or two layers of steel tape.

Serving: Over and above the armouring fibrous material is again provided which is similar to that of bedding but is called as serving.

TYPES OF THREE PHASE CABLES

Belted Cables: In 3 core belted cables, all the three cores of conductors are insulated from each other with impregnated paper. Surrounding the three conductors is again provided with a belt of paper and interstices between them is filled with insulated material.

H Type cables: This cable has no belt insulation, but each of the conductor is insulated with paper to the desired thickness and over it is provided a layer of metallised paper perforated to facilitate the process of impregnation. The fibrous material in the centre and along the filler spaces gives the round shape to the cable. Over this comes the copper woven tape so that the lead sheath, the binder of the metallised foil are all at earth potential. The layer of braiding, armouring and serving are provided as in the previous case.

S. L. Cables: In this case the individual conductors are first insulated with impregnated paper and are covered with metallic sheath, after which they are laid up and armoured.

H.S.L. Cables: Such a cable is a combination of H type and SL type cable, in which case each conductor is insulated, sheathed with metallised paper and is then lead sheathed. The three cores are then laid up and provided with filler, braided, armoured and finally served.

APPLICATIONS

(i) Wires are used for domestic and industrial wiring.

(ii) Cables of higher voltage capacities are used for transmission of power from generating stations to consumers' points.

(iii) In thickly populated areas and in cities underground cables are preferred though they are costlier and difficult to maintain.

Activity No: 8 **Time Required: 3 Hours**

FAMILIARIZING WITH COMMON ELECTRICAL ACCESSORIES

OBJECTIVES

(i) To familiarize the students with the essential constructional features of different electrical appliances.

(ii) To acquaint the students with the functional aspect of various accessories.

(iii) To introduce the students with the mounting aspect of electrical accessories.

RELATED INFORMATION

There are conductors and insulators. The current is forced through the appliance so that it works satisfactorily and safely. This is possible when proper conditions are ascertained. A good electrical contact is a must. For this purpose, various accessories are employed for convenience and ease. In electrical fittings, these accessories are fitted.

When current flows, heat is produced. The accessories must withstand this heat. Another important factor is the voltage, which demands proper insulation. Therefore, insulation quality is also a pre-requisite for safe working.

The accessories should be mechanically strong enough to bear the abuse of day-to-day rough handling.

Generally porcelain base is employed which has a good insulating properties and is heat resistant too. Bakelite and special quality plastic are also employed for this purpose.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Materials

(i)	Bed switch 230v, 5A	:	one
(ii)	Push button switch 230v, 5A	:	one
(iii)	Tumbler switch, 230 v, 5A	:	one
(iv)	Piano switch 230v, 5A	:	one
(v)	Flush type switch 230v, 5A	:	one
(vi)	Bed switch (hanging type) 230v, 5A	:	one
(vii)	A lamp 230v, 40w/60w	:	one
(viii)	A three-pin socket (flush type) 230v, 5A	:	one
(ix)	Three-pin socket (protruding type) 230v, 5A	:	one
(x)	Three-pin plug top 230v, 15A	:	one
(xi)	3 pin plug 230v, 5A	:	one
(xii)	Connector 230v, 15A	:	one
(xiii)	Ceilingrose	:	one
(xiv)	Batten holders (Brass)	:	one
(xv)	Pendent holder (Brass)	:	one
(xvi)	ICDT main switch 250v, 15A	:	one
(xvii)	Kit-kat fuse 230v, 5A (base and carrier)	:	one
(xviii)	Round Block 8 cm	:	one

Equipment

(i)	AVO meter (multimeter)	:	one

TOOLS

(i)	Neon Tester	:	one
(ii)	Insulated combination pliers 15 cm	:	one
(iii)	Screw Driver 8 cm	:	one

Switches

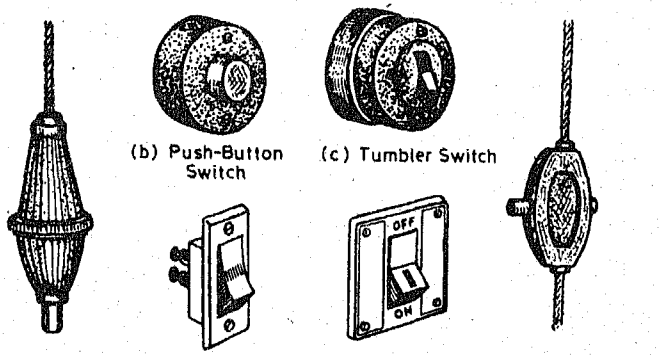


Fig. 8.1 Types of Electrical Switches

Various types of switches are shown in the fig. 8.1. The switches are used to make the circuit on and off. The switches are rated for 5 amps and 15 amps. The switches are mounted on switch boards. The switches are made up of bakelite bodies. Some have a porcelain base. The switches have two terminals and two holes for mounting the base.

Lamps

Lamps are used to get light from electricity. They are of different wattages 40 W, 60 W. and 100 W. They are fixed in the lamp holders

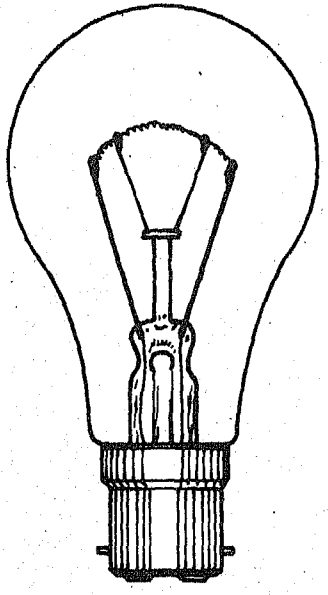


Fig.8.2 Lamp

Wall Sockets

The wall sockets are made up of bakelite bodies. Sometimes the base is made up of porcelain. They are used for connecting various portable appliances such as iron, mixer, heater, geyser etc. They are fixed on the switch boards. The wall sockets are of 5 amps and 15 amps.

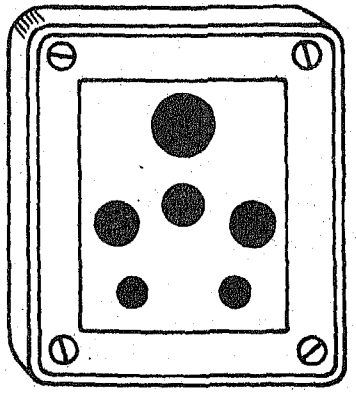


Fig.8.3 Three-pin Socket (Flush type)

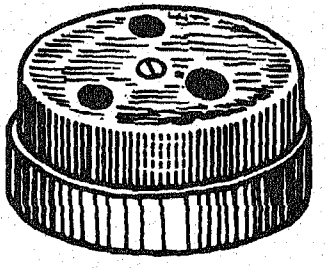


Fig.8.4 Three-pin Socket

Plug

Plugs are also made up of bakelite or good quality plastics. They have three brass/metallic pins. The third one (top pin) is usually bigger and longer in size. It is meant for earth connection. A plug in position is shown in Fig. 8.5.

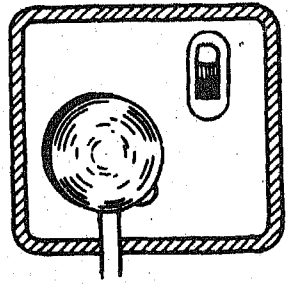


Fig.8.5 Plug inside a Socket

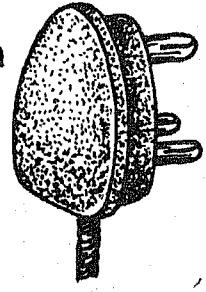


Fig.8.6 3 Pin Plug 5A

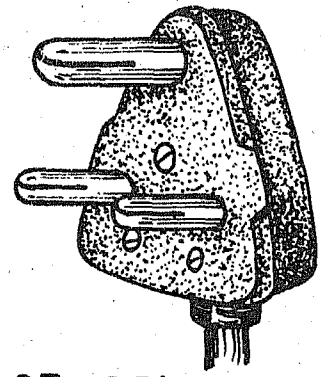


Fig.8.7 3 Pin Plug 15A

Ceiling Rose

Ceiling rose is made up of bakelite. It is screwed on the ceiling on the plastic round base. It is used for taking connection for a ceiling fan, pendent lamp holder, etc.

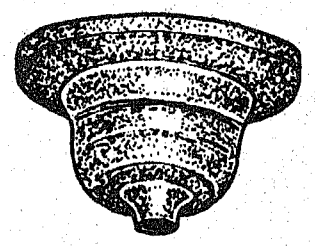


Fig.8.8 Ceilingrose

Batten Lamp Holder

Batten lamp holders are of two types; the brass type and the bakelite type. They are used to hold lamps. They are mounted by wood screws on the round blocks.

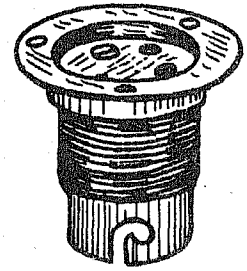


Fig. 8.9 Batten Holder (Brass)

Pendent Lamp Holder

Pendent lamp holder may be of brass or plastic type. It is quite similar to batten holder. They are used for "test lamp" and for hanging lights. Usually they are suspended from a ceiling rose.

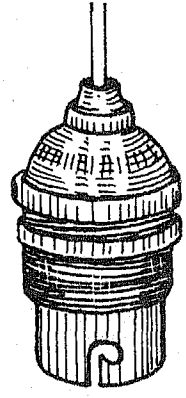


Fig. 8.10 Pendent Holder (Brass)

Main Switch

A main switch is called iron clad main switch. The body is made up of iron. Inside there are two kit-kat fuse. One acts as a fuse carrier. The other is for neutral unit. There is a lever which operates the links to make simultaneously connect or disconnect the switch. The switch cannot be opened unless it is put off.

It is mounted on the Switch Board, very often near the energy meter. The body of the switch is connected to the earth. The switches are available for 5 amps, 15 amps and 30 amps with kit-kat fuse.

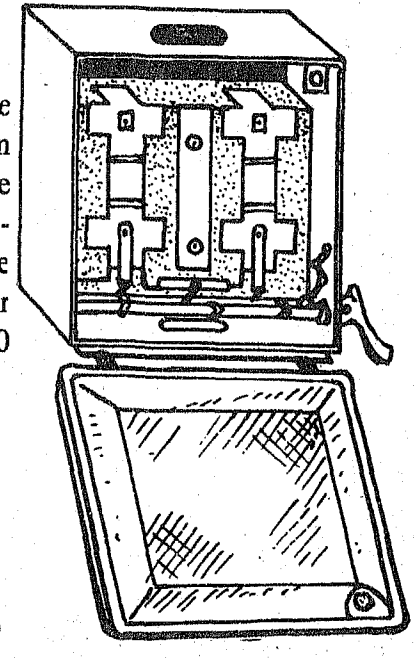


Fig. 8.11 ICDP Main Switch

Kit-Kat fuse

They are made up of porcelain. The incoming and outgoing lines are connected to the base and fuse carrier. When the fuse wire is inserted in the fuse carrier it completes the circuit through the fuse wire. It saves the circuit in case of short circuit and over load.

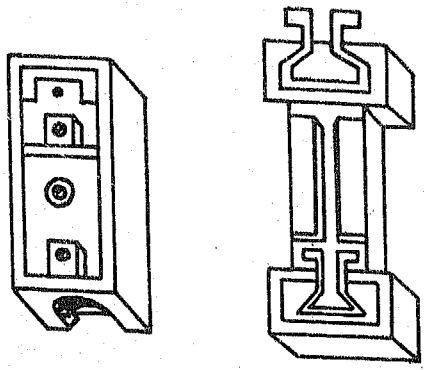


Fig.8.12 A Kit-Kat Fuse base and Carrier

Round block

It is made up of wood, used as a base for batten holders brackets, ceiling rose, switches etc. It is mounted on the wall with two wood screws.

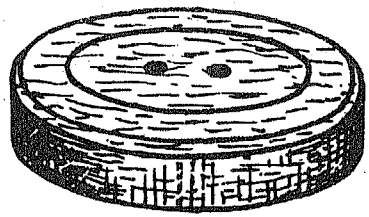


Fig. 8.13 Round Block

PRECAUTIONS

(i) The switches should be connected on live wire.
(ii) Use proper size screw driver to the various screws.
(iii) Use balanced force to open/assemble any part.
(iv) Avoid over tightening of a screw. It will break the accessory.
(v) Do not keep loose frayed connections.

APPLICATIONS

All electrical fitting requires the various accessories for the convenience of connections.

Now a days the accessories are made up of better look, provided with good mechanical strength and good insulating materials. Good quality accessories prove cheaper in the long run.

Activity No.9 **Time Required: 2 Hours**

PREPARING A TEST LAMP

OBJECTIVES

(i) To impart skills and knowledge for making a test lamp.
(ii) To provide opportunities for the use of test lamp.

RELATED INFORMATION

We need indication of light to be sure of presence of electricity. This may be required for finding the circuit to be "LIVE" or "NOT". A test lamp may be connected in series or parallel with supply for testing. The glow of the lamp indicates presence of voltage in the supply line.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Tools

(i)	Screw Driver 10 cm long	:	one
(ii)	Neon Tester	:	one
(iii)	Cutting Pliers 15 cm	:	one
(iv)	Combination pliers (insulated) 15 cm	:	one
(v)	Electrician's knife	:	one

Materials

(i)	Pendent Lamp Holder	:	one
(ii)	40 Watt Lamp	:	one
(iii)	3/20 Wire (2 pieces: Red, White)	:	1 Metre

PROCEDURE

Take two pieces of wires about half a metre long each. Remove insulation from each end of the wires of about 1 cm long. Twist naked wire ends by plier. Then weave the insulated wires in the form of a rope (See Fig. 9.2).

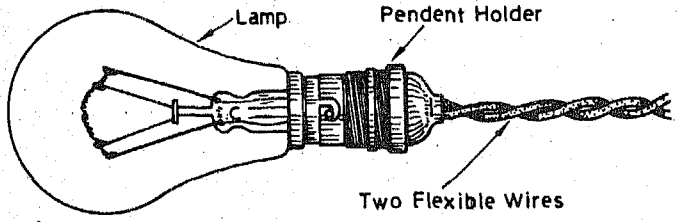


Fig.9.1 A Typical Test Lamp

Open out the pendent holder. Unscrew the screws for connection (See Fig. 9.2).

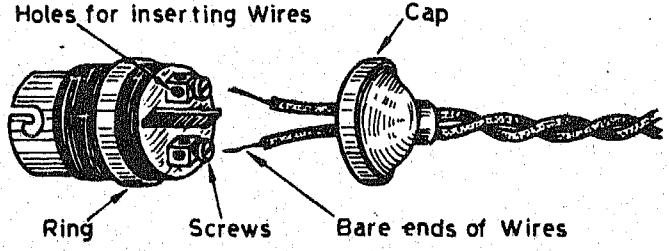


Fig.9.2 The dismantled pendent lamp holder

Then, insert the cap of the pendent holder at one end of the wires. Insert naked ends of the wires in the holder holes and tight them in position with screws.

Screw up the cap. Insert the 40 Watt lamps in the holder. The test lamp is ready for use as shown in Fig. 9.1.

PRECAUTIONS

(i) While removing the insulation the wires should not be cut.

(ii) Make tight connections.

APPLICATIONS

A test lamp is also called series testing lamp. It is used to check the

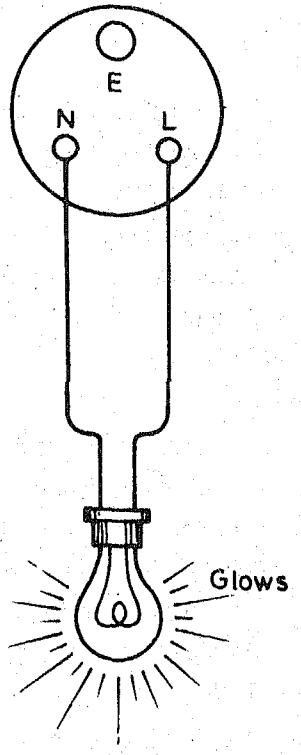


Fig.9.3 Checking Presence of Electricity

presence of electricity. The following uses are generally found :

(i) For checking presence of electricity at 3-pin socket, connect the test lamp as shown in Fig. 9.3. The glow indicates that the electricity is present.

(ii) For checking the earth connection at 3-pin socket, make the connections as shown in Fig. 9.4. The glow shows that the earth connection at 3-pin socket is alright.

It can be used to check the presence of electricity at various connections. The earth connection may also be checked at various places. Such as main switch, switch boards, energy meter etc.

It is an indispensable tool in checking continuity, open circuit, short circuit, leakage and earth fault.

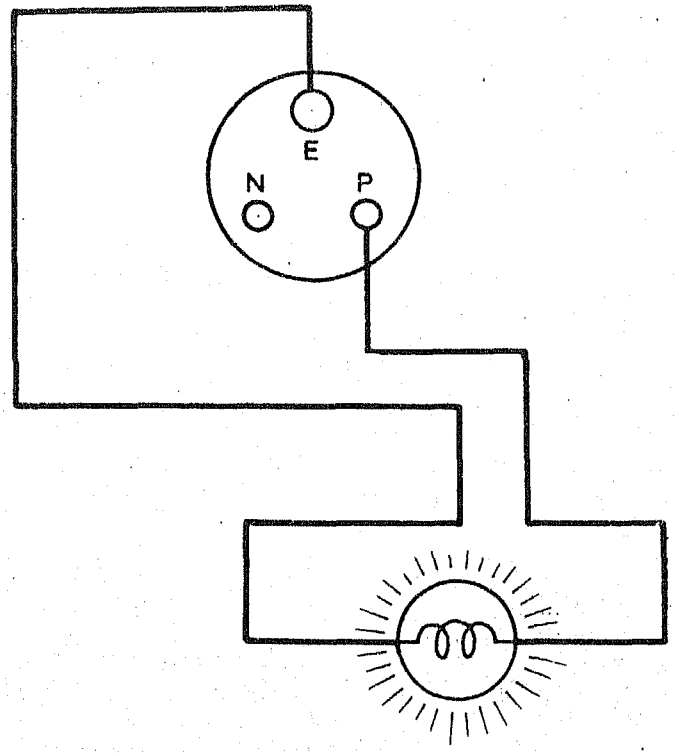


Fig.9.4 Earth Connection Test

Activity No. 10 **Time Required: 2 Hours**

FAMILIARIZATION WITH SERIES AND PARALLEL CIRCUITS

OBJECTIVES

(i) To make the students aware of the series and parallel connections.

(ii) To make the students understand the differences between series and parallel circuits.

(iii) To acquaint the students with the uses of series and parallel circuits.

RELATED INFORMATION

Circuits are made up of series and parallel connections. Any circuit howsoever complex may be has basically the series and parallel connections only.

In series the connections are made one after the other so that there is only "ONE PATH" for the current flow.

However in parallel connections the connections are made at the two terminals only. We have as many paths for the current flow as the number of appliances connected.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Tools

(i)	Insulated Combination pliers 15 cm	:	one
(ii)	Neon Tester	:	one
(iii)	Screw Driver	:	one
(iv)	Electrician knife	:	one
(v)	Rubber mat 3′—0″×2′—0″×⅛″	:	one

Equipment

(i) Voltmeter AC/DC 230 V : one
(ii) Ammeter AC/DC 0–5 Amp : one

Materials

i) Test Lamps : 3 nos.
ii) 220 V AC/DC Supply

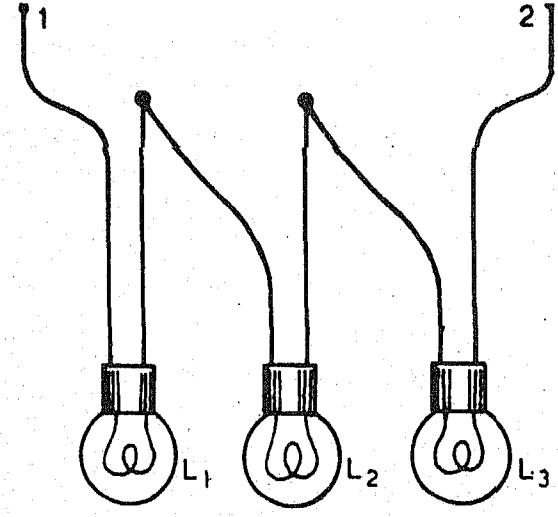


Fig.10.1 Lamps in series

(iii) Insulation tape
(iv) Connecting Wires

PROCEDURE

Take three test lamps and make the connections as shown in the Fig. 10.1. The connections seem to form a long string. Only two ends are left, where the supply is given as shown in Fig. 10.2. Make a note that there is only one path for the current flow. This is a series connection.

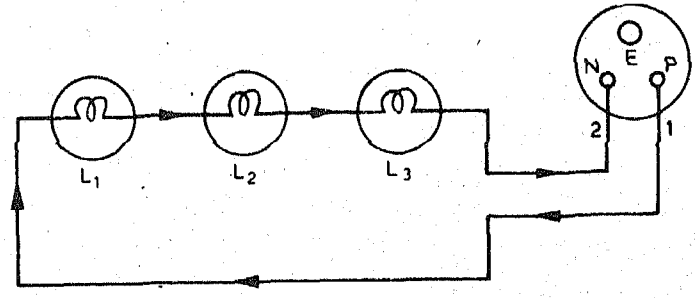


Fig.10.2 Lamps in series connected to supply

Now, the parallel connection is made by connecting the two ends of one test lamp with that of the other. The two ends thus formed are connected with the third test lamp. Finally we are left with only two "ends". There are as many paths of current flow as are the number of lamps.

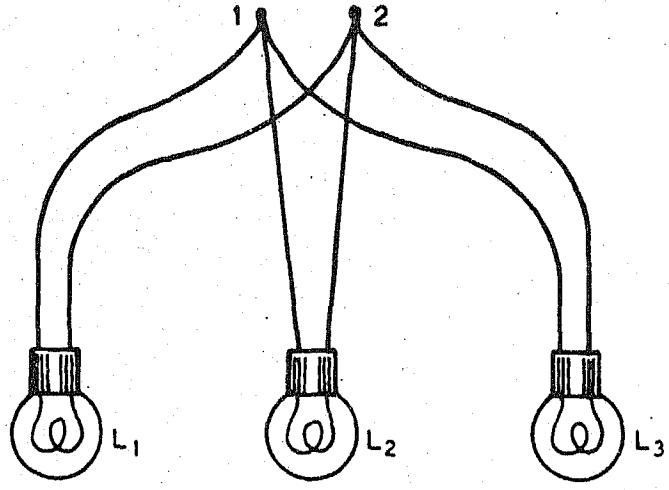
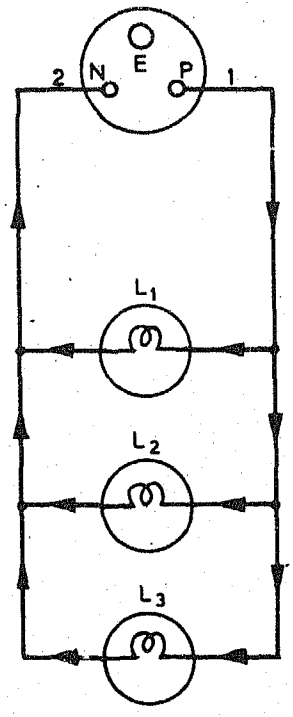


Fig.10.3 Lamps in parallel

DIFFERENCES IN SERIES AND PARALLEL CONNECTIONS

Series Connection:

(i) There is only"one path" for current flow (See Fig. No. 10. 2.). Therefore the same current flows throughout the circuit.



(ii) Either all the lamps will glow or none of them will glow in case any one of them is fused or goes out of order. You may see series lamp connection in the festive lights on various occasions (See Fig. 10.5).

Fig.10.4 Lamps in parallel connected to supply

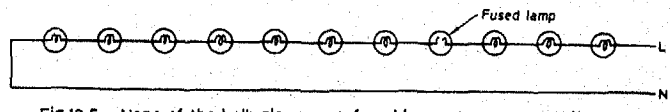


Fig.10.5 None of the bulb glows as a fused lamp stops current flow.

(iii) Voltage is different across different wattage lamps (See Fig. 10.6).

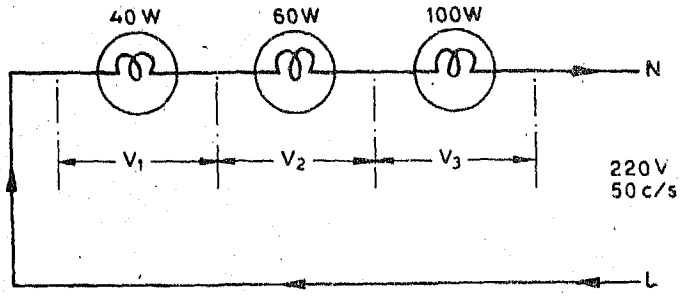


Fig. 10.6 Voltage differs across different resistors in series connection

(iv) The resistance increases when the lamps are connected in series. Therefore the current is less.

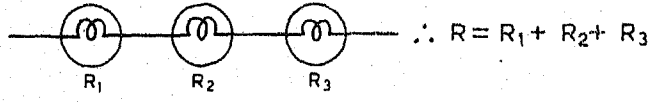


Fig. 10.7 Different resistors increase the resistance when connected in series

Parallel Connection

(i) There are as many paths for the current flow as there are number of lamps (See Fig. 10.4).

(ii) If any lamp goes out of order the other lamp will continue to glow. Therefore independent control is possible. This is the reason for using the parallel connection in domestic wiring. All the appliances that are used in our homes are connected in parallel (See Fig. 10.8).

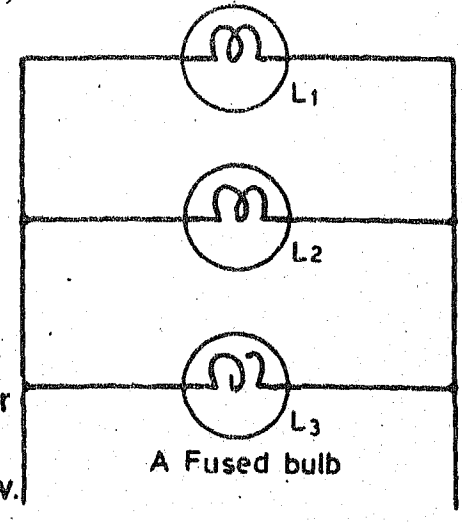


Fig. 10.8 Lamp L_1 will not glow. However L_2 and L_3 will continue to glow.

(iii) All the appliances will have the same voltage when connected in parallel. This is essential so that all the appliances can work on their designed voltage (See. Fig. 10.9)

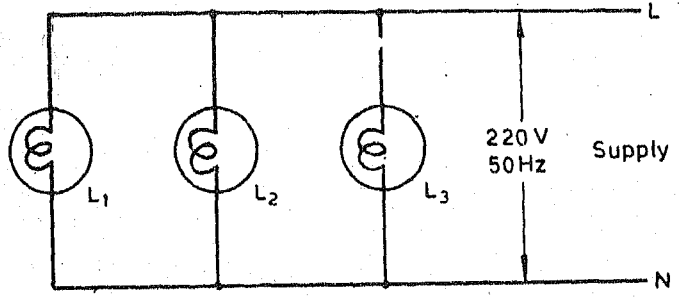


Fig. 10.9 Same Voltage is available to all the lamps.

(iv) The total resistance decreases as the appliances are connected in parallel. The equation is as follows:

$$\frac{I}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

PRECAUTIONS

(i) Do not touch any bare wire when connected to mains supply.

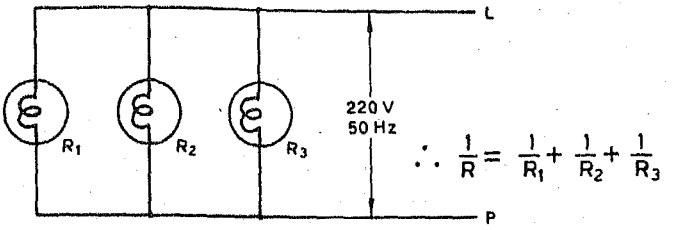


Fig.10.10 The total Resistance decreases

(ii) Make tight connections.

(iii) Avoid frayed or loose connections.

APPLICATION

(i) The series connection is used in decoration lights on festivals. Either all the bulbs will glow or even when one of them is fused none of them will glow. Independent control is not possible in the series connection.

(ii) The parallel connection is used in domestic wiring. All the appliances are designed to work on 220 V A.C. and hence parallel connection is to be used. In parallel connection independent control is possible. Even when one appliance has a defect the others will continue to work.

Activity No: 11 **Time Required: 3 Hours**

SELECTING, AFFIXING AND WIRING A FUSE

OBJECTIVES

(i) To impart knowledge to the students for selecting a fuse.
(ii) To train the students to wire a fuse.
(iii) To train the students to affix a fuse.

RELATED INFORMATION

The fuse is a safety device. It protects the circuit from over-load. When current exceeds the maximum limit, the use melts and breaks the circuit and current ceases to flow.

The fuse also blows out in the case of a short-circuit. A short-circuit is caused due to contact of Live and Neutral ires without any load being connected.

Both the over-load and short-circuit (S.C.) are dangerous. If these conditions prevail the wiring gets heated up and there is a chance of fire.

The fuse is always provided before the switch and is placed on the Live wire.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Materials

(i)	Fuse carrier (Kit-Kat) 5 amps	:	One
(ii)	Fuse Carrier (Kit-Kat) 15 amps	:	One
(iii)	Fuse wire 5 amps	:	One metre
(iv)	Fuse wire 15 amps	:	One metre
(v)	Switch board (20 cm×20 cm)	:	One
(vi)	Wooden screws 12 mm	:	Six

(vii) Hand drill with drill bit of 5 mm : One
(viii) Saw dust or chalk powder : 25 gm
(ix) Two wires (3/20 size) each 1 metre

Tools

(i) Insulated combination pliers (15 cm): one
(ii) Cutter (15 cm) : one
(iii) Screw driver (10 cm) : one
(iv) Neon tester : one
(v) Poker (10 cm) : one

PROCEDURE

SELECTION

A fuse is a protective device. It is placed on a Live-wire before the switch as shown in Fig. 11.1. Fuse protects circuit from over loading. It burns out and acts as a safety device.

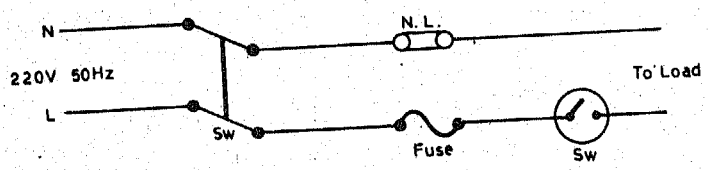


Fig. 11.1 Connection of a Fuse and a Switch in circuit

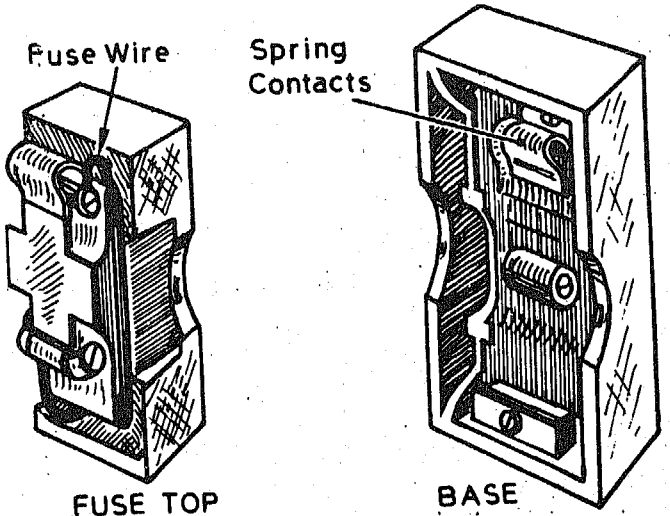


Fig.11.2 Fuse Carrier and Fuse Top

Fuses are of two ratings, 5 amps and 15 amps for house wiring. The 5amps fuse is generally employed for lighting. The 15amps fuse is used for power circuits. For selecting a fuse the total load is calculated by adding the wattages of all the appliances to be connected to a circuit. The total current drawn is found by dividing the total wattages by the voltage.

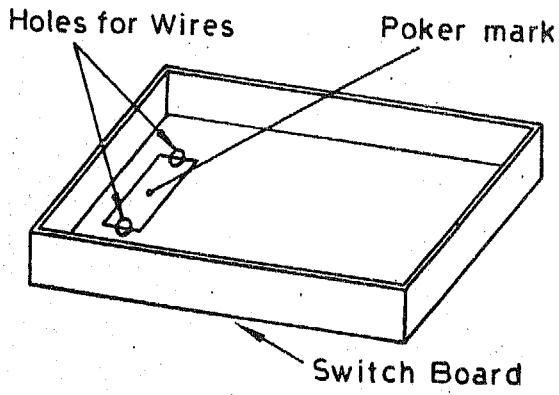


Fig. 11.3 Layout diagram on a Switch Board

Example: A circuit has two lamps of 100 Watt each, 3 tube lights of 40 watt each, 2 ceiling fans of 80 Watt each.Find the fuse needed when working voltage is 220 V.

Solution: The total load=Lamps Wattages+T.L. Wattages+ Fan Wattages

$= 2 \times 100 + 3 \times 40 + 2 \times 80$ Watts

$= 200 + 120 + 160$ Watts $= 480$ Watts

$$\text{Current} = \frac{\text{Total Wattage}}{\text{Supply Voltage}} \text{ amps} = \frac{480}{220} = 2.18 \text{ amps.}$$

2.18 ampere is less from 5 amperes, Therefore,

5amps fuse will be required,

Example: A circuit has a hot plate 2 KW working at 220 V. Find the fuse required.

Solution: Total load = 2000 W

Voltage = 220 V

$$\text{Current} = \frac{\text{Total Road}}{\text{Voltage}} \text{ amps} = \frac{2000}{220} \text{amps} = \frac{100}{11} \text{amps}$$

9.09 amps

9.09 amper is less than 15 amperes, Therefore

15 amps fuse will be required,

WIRING A FUSE

After selecting the fuse the required length of fuse wire is cut. It will be generally about 8 to 10 cms long for 5 amps

fuse and about 10 to 15 cms long for 15 amps. The desired length may be measured by actual measurement of the fuse holder. Always keep extra length of about 5 cm long so that few turns are given around the screws.

Take the fuse wire and fix one end on the fuse holder (top). Avoid any frayed connection. Now, pass the wire through the hole provided in fuse-top and screw-up the other end of the fuse wire by giving a few turns in clockwise direction. Cut extra length of the fuse wire.

Now, the fuse-top is ready for insertion into the fuse-base as shown in Fig. 11.2.

AFFIXING A FUSE

Place the fuse-base on the top of the switchboard where it is to be fixed. Hold it by left hand and put some saw-dust/chalk powder over the three holes. Gently lift the fuse-base and keep it aside.

With the help of poker initiate three holes a little. Now, drill two-holes (extreme ones) using the hand-drill or electric-drill employing 5 mm drill bit.

Connect two-wires (3/20) one at each terminal to the fuse-base and pass them through the drilled holes. Now, take a wooden screw and screw-up through the central hole aligning it with the mark of that of the poker. Put the fuse-top on the base.

PRECAUTIONS

(i) Select the proper fuse. 5amps for lighting loads and 15 amps for power loads.

(ii) Avoid frayed-connections. Extra length of fuse wire, must be cut, after connection.

(iii) Always make tight connections.

(iv) Do not keep the fuse sagging. It must remain within the fuse-top.

(v) Do not use any other wire in place of fuse-wire. Never use a thicker wire or a copper wire.

APPLICATIONS

All electrical circuits are protected by fuse. Fuses are rated according to their current carrying capacity. There are many types of fuses. The fuses that are used in House-hold wiring are re-wireable type. Whenever the fuse blows out the fault must be found. Ignoring this may result in

blowing out of fuse again and again. The fuse blows on account of

(i) Over loading
(ii) Short-circuit
(iii) Ageing.

If there is an over-load, disconnect some of the appliances. A short-circuit must be removed or else again fuse will blow out. However when ageing is the cause, it may be replaced without much concern. You should wait and watch to see the normal performance.

Activity No: 12

Time Required: 3 Hours

FAMILIARIZATION WITH VARIOUS HOUSEHOLD APPLIANCES

OBJECTIVES

(i) To familiarize the students with the various household appliances.

(ii) To acquaint the students with the connection of electrical appliances to the supply.

RELATED INFORMATION

All the electrical appliances used at home consume electrical energy. The rate at which the energy is consumed is expressed in watts. Higher the wattage, the more one pays for its use.

All the appliances are connected in parallel. They are connected to 220v/230v, 50Hz supply. The supply has three terminals live (L), Neutral (N) and Earth (E). The portable appliances having metallic body must be connected to earth. The electrical appliances convert electrical energy into light, heat, mechanical energy.

Lamp: Lamps are available in different wattages such as 15w, 25w, 40w,

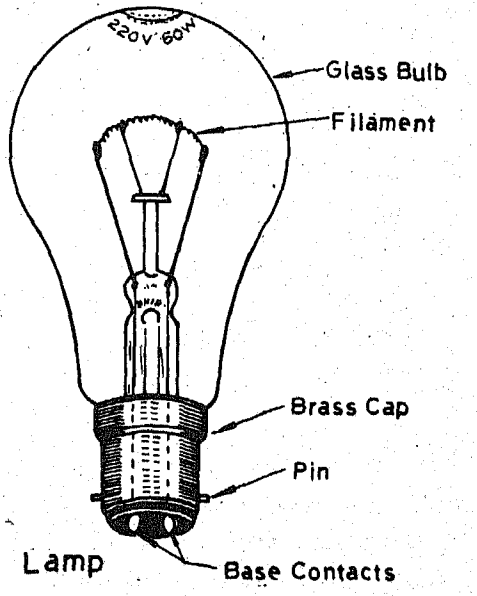


Fig. 12.1 Lamp

60w, 100w, 150w, 200w. All these lamps work on 220v /230v, 50 Hz supply.

The lamps are made up of glass envelope which may be transparent, frosted/milky and coloured. They have a metallic cap made up of brass/aluminium. There are two base contacts which press against the pins provided in the holder.

Tube light. Tube lights are generally of 20w, 40w and 80w. They work on 220v/230v, 50c/s supply.They are available in various lengths such as 2 feet, 4 feet and 5 feet.

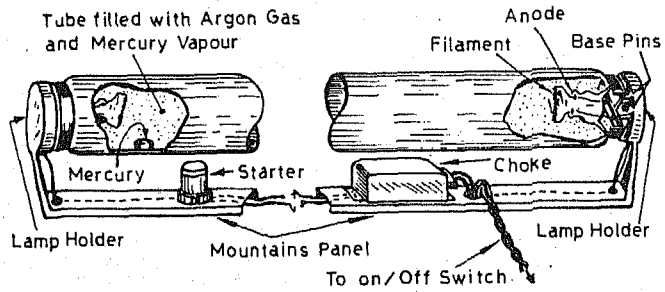


Fig. 12.2 Tube Light

A tube light has mounting panel with holders on either side. It contains a choke and a starter. There is a tube made up of glass which emits light.

In a tube light the choke is connected in series and the starter is connected in parallel. An on-off switch is also incorporated to put it on and off.

Room Heater. A room heater is available in 1000w, 1500w and 2000w. It works on 220v, 50 c/s supply. Basically there are two parts of a heater. The first one is the reflector

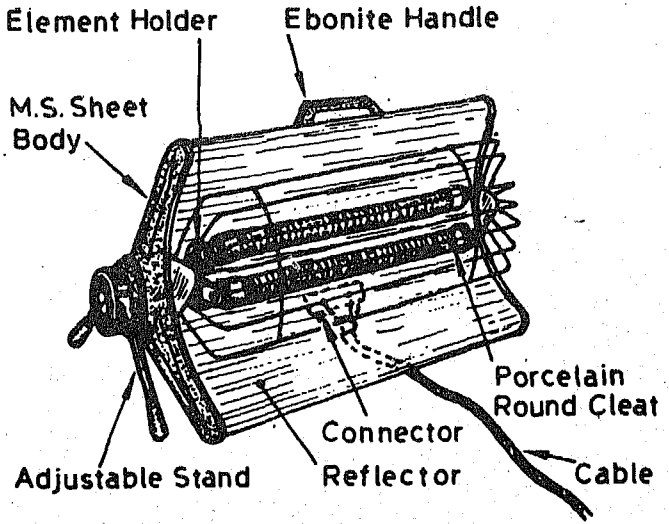


Fig. 12.3 Room Heater

made up of mild steel sheet. The reflector has a round/longitudinal shape. It has a highly polished inside surface which requires periodical cleaning to reflect the heat effectively. The other part is the heating element. It is mounted on porcelain base with several turns of nichrome wire in the form of a coil. It is connected to a power socket as it consumes current above 5 amperes.

Ceiling Fan: The ceiling fans are available in various sizes. It is given in sweep diameters which are usually 42", 48" and 56". The fans are generally of 60w, 80w and 100w. Fans operate on 220v/230v, 50 c/s supply.

The fans are provided with an on-off switch along with a regulator. The regulators may be resistance type/ electronic type-known as step-less control. The regulator is connected in series with the fan-motor.

Table Fan: A table fan is used as a portable appliance for providing air at a small place. They are generally of about 60w and operate on 220v/230v, 50 Hz supply. The table fan has a rotating mechanism which is optional. It also has a regulating knob with which the speed may be controlled.

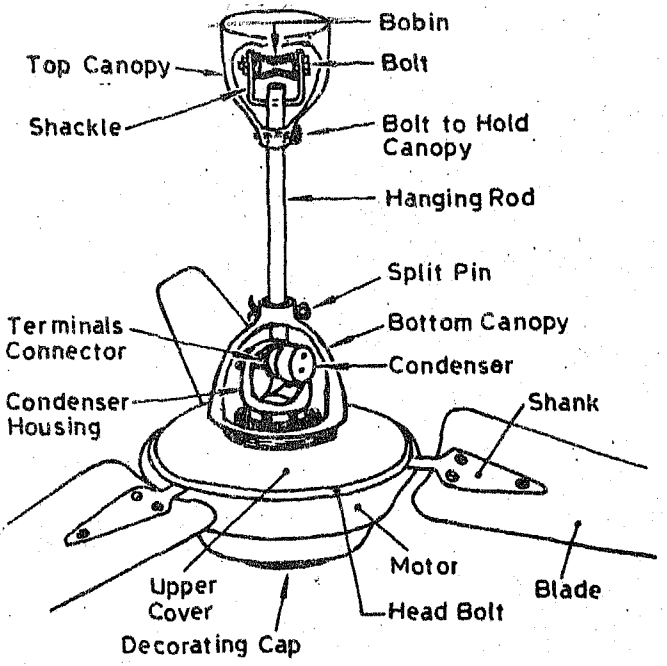


Fig. 12.4 Ceiling Fan

A table fan is usually connected through two-pin plug top to the supply.

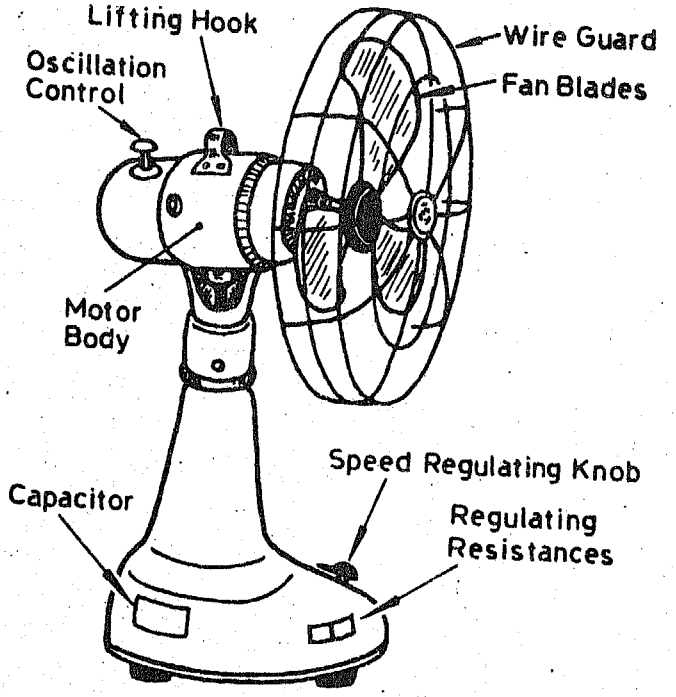


Fig. 12.5 Table Fan

Electric Iron: An electric iron is available in 500w, 700w, 1000w and works on 220v/230v, 50c/s supply . They are also specified according to weight e.g. 1 kg, 3 kg, 4 kg or 5 kg.

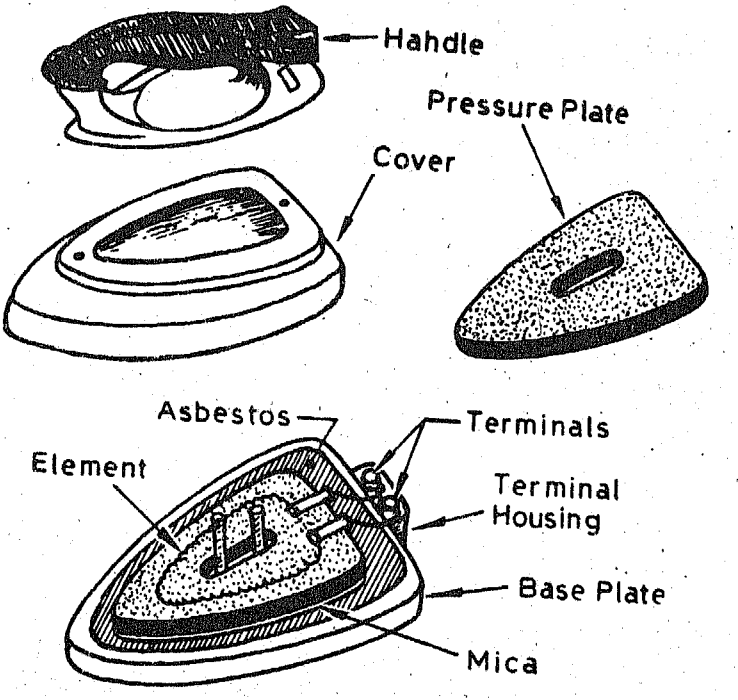


Fig. 12.6 Electric Iron

Fig. 12.6 shows the various components of an electric iron. The main part is the heating element placed in mica sheets. On the top of element is placed asbestos sheet which has a pressure plate screwed on to it. The cover, handle and the terminal box are other important parts.

The iron should be used on power point preferably. It employs a conector for the necessary connection. Sometimes it is made integral with the body of an iron.

Now-a-days automatic iron has come into use which has a thermostat in it. The steam iron is also being used these days.

Heater : A heater is used for general heating purposes especially for cooking and boiling liquid. They are of high wattage 1000w, 1500w, and 2000w and work on 220v/230v, 50 Hz supply. There is a coiled heating element placed in the housing of a porcelain base. It is connected to mains by a connecting cord which has a connector attached to one of its end. It must be operated on a power socket.

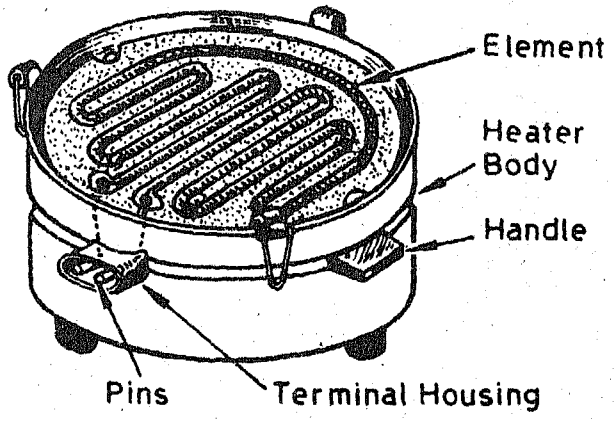


Fig. 12.7 Heater

Table Lamp : A table lamp employs a bulb of 40w/60w /100w. There are some special lamps also available in the market. All lamps work on 220v/230v, 50 Hz supply. The main parts of a table lamp parts arer show in Fig. 12.8. It is connected to supply at a light load (5 ampere socket) which

is usually through a two-pin plug.

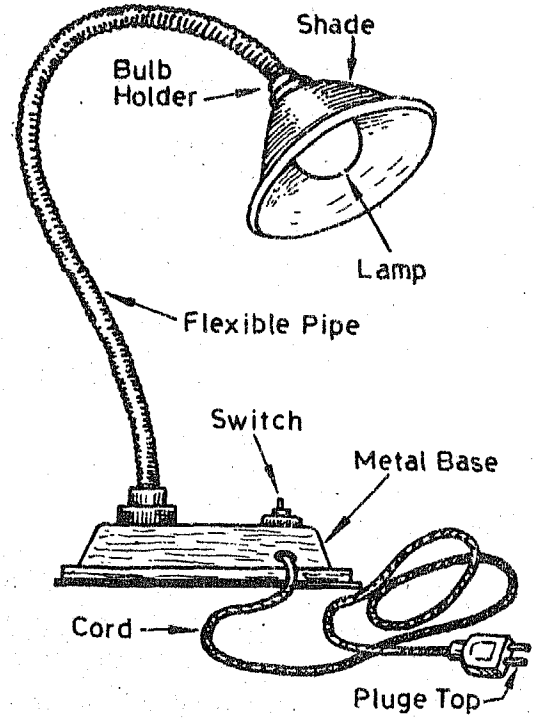


Fig.12.8 Table Lamp

Immersion Rod : Immersion-rod is a high wattage appliance (1000w/1500w/2000w). It works on 220V/250V 50c/s supply. It must be operated from a power point of 15 amps. This should never be put-on while the rod is not immersed in the water. Otherwise the rod element will burn out instantaneously.

Electric Kettle: The kettle is usually employed for preparing tea/coffee or for heating water. A kettle is generally of

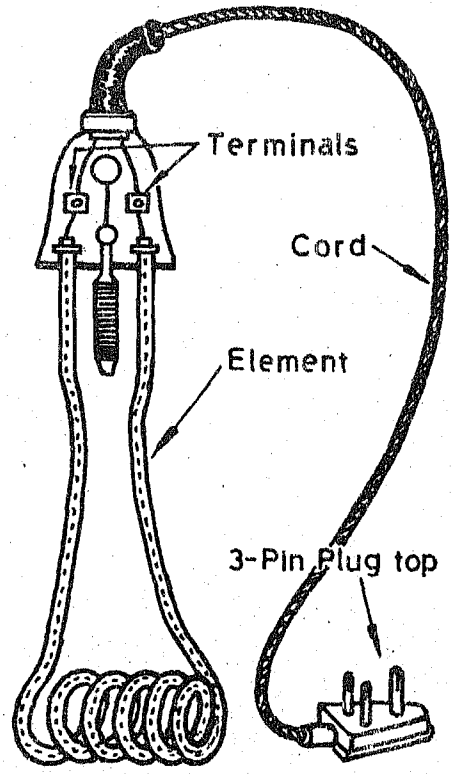


Fig.12.9 Immersion Rod

250w and works on 220v/230v, 50 c/s supply. It is connected to A.C. mains voltage by a connecting cord with connector on one end and three-pin plug top on the other.

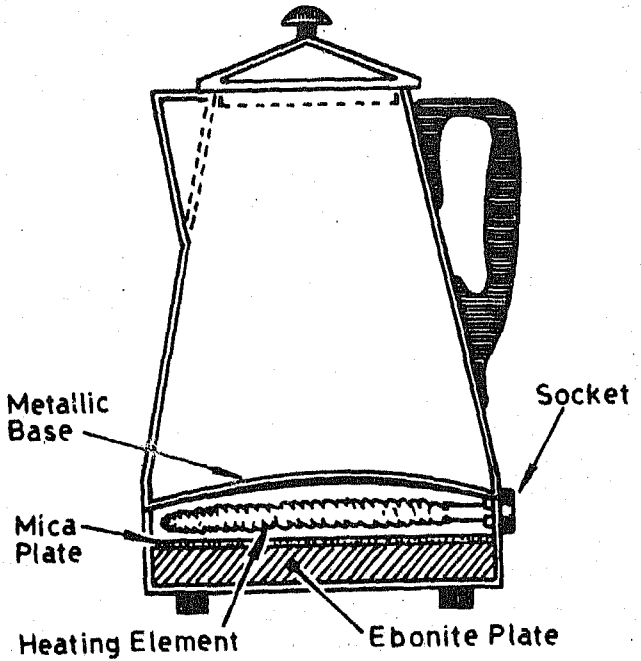


Fig.12.10 Electric Kettle

Electric Mixer: An electric mixer uses a very high speed motor and is used in kitchen for mixing, blending, beating, etc. The various parts may be seen in Fig. 12.11. Two jars are used in a mixer. The long one is used for wet mixing and the short one is employed as a dry grinder.

The mixer has a moulded plug. This may be operated on a light/power socket.

Hair Dryer :A hair *dryer* is generally of 750w or 1200w

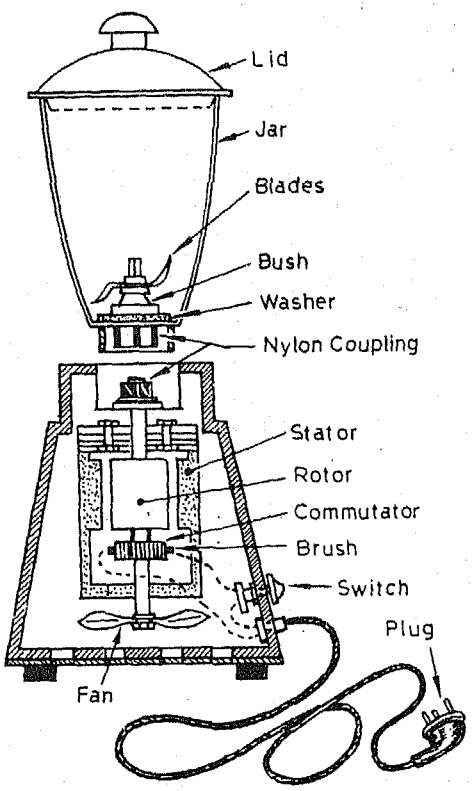


Fig. 12.11 Electric Mixer

and employs a heater and a motor. It works on 220v, 50 Hz supply. Both heater and motor are connected in parallel and hence operate simultaneously.

The various parts may be seen in Fig. 12.12. It can be operated on lighting or on power-socket.

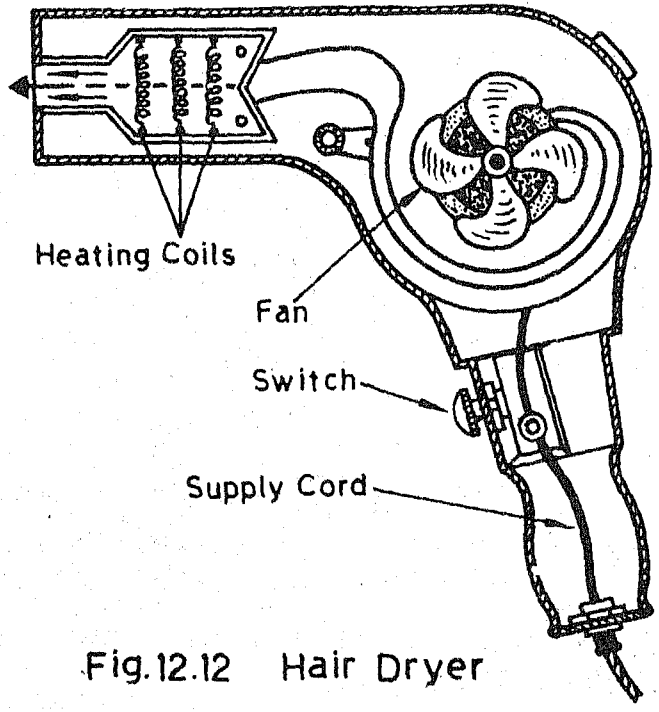


Fig. 12.12 Hair Dryer

PRECAUTIONS

(i) Understand the operation of an appliance before operating it.

(ii) All portable appliances having metallic bodies must be earthed and should be operated from 3-pin socket.

(iii) Do not dismantle an appliance, unless you know about it.

(iv) High wattage appliance should be operated on power-socket only.

TOOLS REQUIRED

(i)	Neon Tester	:	one
(ii)	Insulated Combination pliers 15 cm	:	one
(iii)	Screw driver 15 cm	:	one

MATERIALS REQUIRED

(i)	Lamp 60w 230v	:	one
(ii)	Tube light fitting complete	:	one
(iii)	Room heater 1000w, 230v	:	one
(iv)	Ceiling fan 80w, 230v	:	one
(v)	Electric iron 750w, 230v	:	one

(vi) Table fan 60w, 230v : one
(vii) Heater (ordinary) 1 Kw, 230v : one
(viii) Immersion rod 1 Kw, 230v : one
(ix) Electric kettle 500w, 230v : one
(x) Electric mixer 80w, 230v : one
(xi) Hair dryer 750w, 230v : one
(xii) Table Lamp 60w, 230v : one

Note: The teacher should explain the operation of all the appliances to the students and allow them to handle the appliances. Students should observe the name plate of the appliances and then put them in use in the class room.

Activity No. 13 **Time Required: 5 Hours**

TESTING OF HOUSEHOLD ELECTRICAL APPLIANCES

OBJECTIVES

(i) To familiarize the students with the basic faults, viz, Open circuit, short circuit,leakage and earth.

(ii) To test a given appliance for open circuit/short circuit/leakage/earth fault.

RELATED INFORMATION

Electricity flows only in a closed circuit. Whenever there is a break in the circuit, the current stops flowing in the circuit. The appliances does not work. Such a fault is caused by open circuit (O.C.) fault.

When the current does not flow through the element/ filament and instead the "Live" and "Neutral" touch each other a short is created. Then the fuse blows out. Such a fault is known as short circuit (S.C.) fault.

The current when flows through the body of an appliance a leakage/earth fault is said to exist.

TOOLS REQUIRED

(i) Screw Driver (10 cm) : one

(ii) Neon Tester/Line Tester : one

(iii) Insulated combination pliers (15 cm). : one

EQUIPMENT REQUIRED

(i) Test lamp : one

(ii) House Hold appliance such as Electric Iron/Heater/ Immersion Rod : one

MATERIALS REQUIRED

(i) 3/20 Insulated wire: 2 metres

PROCEDURE

The current flows in a closed circuit. Therefore, continuity must be present. Whenever there is a break in the circuit, the current does not flow. This is called open circuit (O.C.) fault.

An open circuit is caused in the following ways:

(i) The burnt out filament/element.
(ii) A cut/broken wire.
(iii) A loose/open connection.
(iv) A corroded/rusted point.

A short circuit is a condition in which the supply is connected to live and neutral wire without a load. In such a situation, the fuse blows out.

A short circuit is caused due to the following reasons :

(i) Insulation failure.
(ii) Loose connection.

In earth fault, the body of the appliance becomes "live". It carries current. It is hazardous and may prove to be fatal. It may give severe shock. A minor earth fault is known as the leakage fault. In leakage fault appliance may continue to work. However, in earth fault the fuse blows out if the body is earthed.

The earth fault is caused by loose connection and frayed connection in the body of an appliance.

TEST FOR OPEN CIRCUIT

Make the connections as shown in Fig. 13.1.

If the lamp does not glow O.C. fault is present.

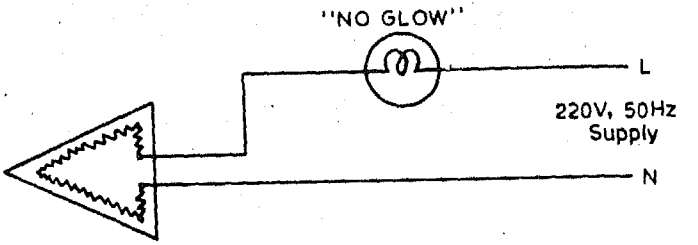


Fig.13.1 The Lamp does not glow, O.C. fault is present.

TEST FOR SHORT CIRCUIT

Connect the test lamp as shown in Fig. 13.2.

If the lamp glows brightly the short circuit is confirmed.

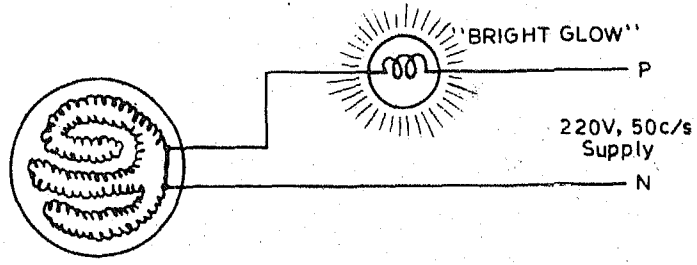


Fig. 13.2 The Lamp glows brightly indicating the presence of Short Circuit.

TEST FOR LEAKAGE AND EARTH FAULT

Make the connections as shown in Fig. 13.3 and

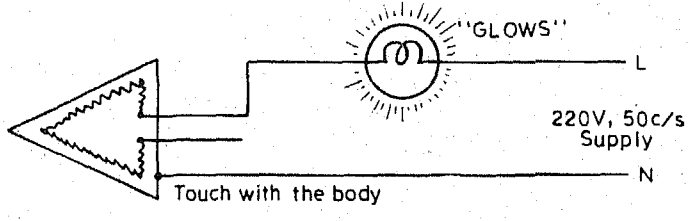


Fig. 13.3 A Reduced glow indicates the leakage fault.

13.4. A glow indicates the presence of these faults. The leakage will have somewhat dimglow, while an earthed fault will show a bright glow.

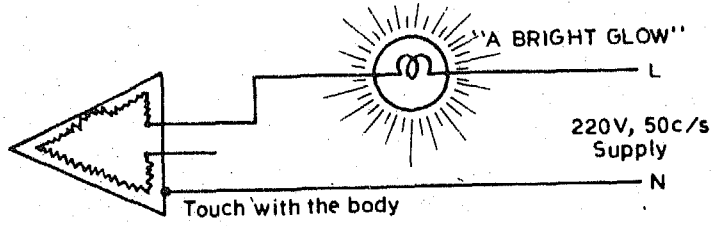


Fig. 13.4 A Bright glow shows that the earth leakage fault exists.

TEST FOR CONTINUITY

When the connections are made as shown in Fig. 13.5 and the lamp glows dim, it confirms the presence of continuity.

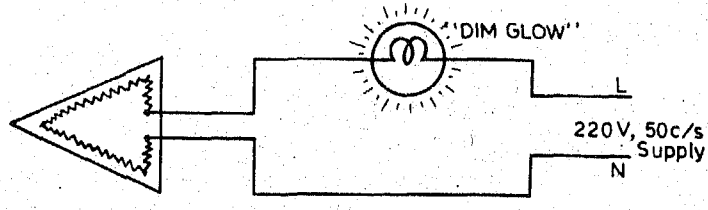


Fig. 13.5 A Dim glow shows that continuity exists in the element of Electric Iron.

PRECAUTIONS

(i) Make tight connections.
(ii) Insulate yourself well.
(iii) Do not touch any bare/naked wire, unless tested by neon tester.
(iv) Work on a 'dead' circuit only.
(v) Do not touch the body of an electrical appliance when leakage/earth test is being conducted.

APPLICATIONS

Appliances do go bad in due course of time. The common faults are O.C., S.C., leakage and earth. None of the fault should exist in the appliance for safe and efficient working. All these tests should be conducted on an appliance before using.

Activity No: 14 **Time Required: 2 Hours**

TESTING OF HOUSEHOLD ELECTRICAL APPLIANCES BY MULTIMETER

OBJECTIVES

(i) To impart the knowledge and skills to use multimeter for O.C., S.C., leakage and earth faults testing.
(ii) To check the continuity of the appliance by multimeter.

RELATED INFORMATION

A multimeter is commonly known as AVO meter. It has several scales for measuring resistance. An open circuit will have infinite resistance. A short circuit on the other hand will have zero resistance. In multimeter different scales are provided for measurement of different quantities (Voltage, current, resistance etc.)

In resistance, generally R,10R, 100R, 1000R, 10,000R, ranges are provided. We select a low range, say R, when low resistance is expected such as in short circuit and continuity check.

The high ranges are selected in open circuit, leakage and earth fault.

TOOLS, EQUIPMENT AND MATERIAL REQUIRED

EQUIPMENT

(i) Multimeter	:	one
(ii) Household appliance	:	one

TOOLS

(i) Screw driver (8 cms)	:	one
(ii) Insulated combination pliers (15 cms)	:	one

PROCEDURE

Open Circuit Test: Make the connection as shown in Fig. 14.1. as no current is able to flow due to break in the element, the resistance indicated is infinite. The needle remains at infinity.

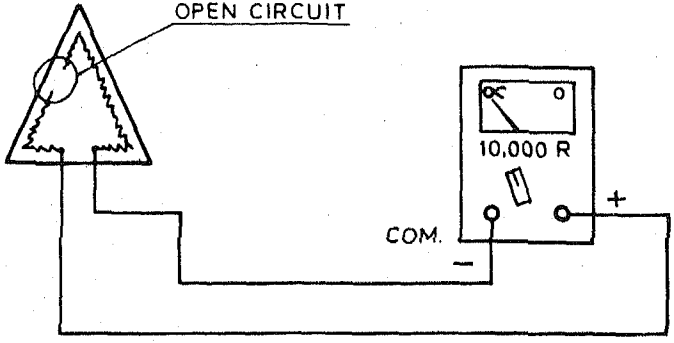


Fig. 14.1 The needle does not deflect at all. O. C. is present.

Short Circuit Test: Make connections of multimeter as shown in Fig. 14.2,Fig. 14.3 and Fig. 14.4 respectively. When a low resistance reading is obtained the leakage is indicated. When the value comes as zero the earth fault is present.

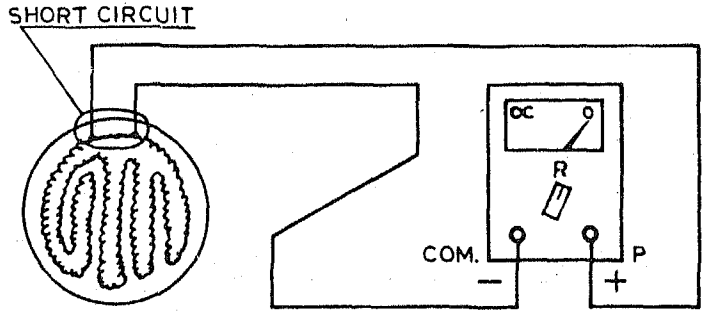


Fig. 14.2 The needle deflects to zero. S. C. is present.

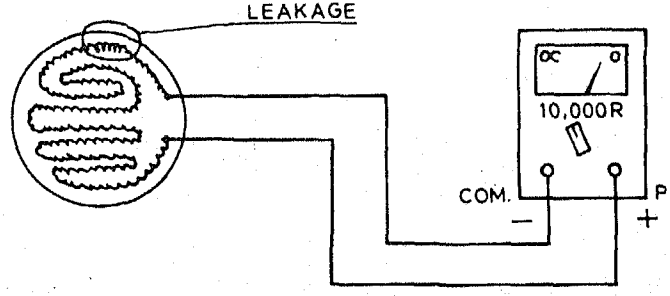


Fig. 14.3 The needle deflects to a low value, showing that the leakage fault is present.

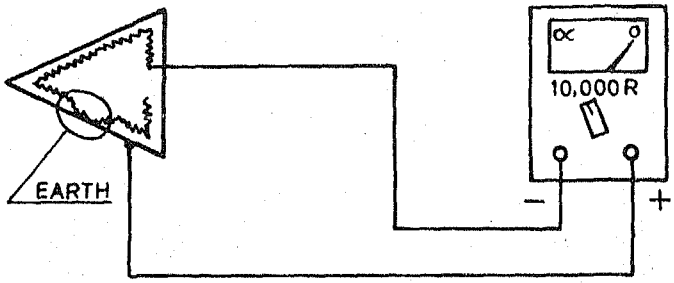


Fig.14.4 The needle goes to zero, showing that the Earth fault exist.

Continuity Check: Connect the multimeter as shown in Fig. 14.5. A low resistance value (depending upon the appliances) indicates continuity.

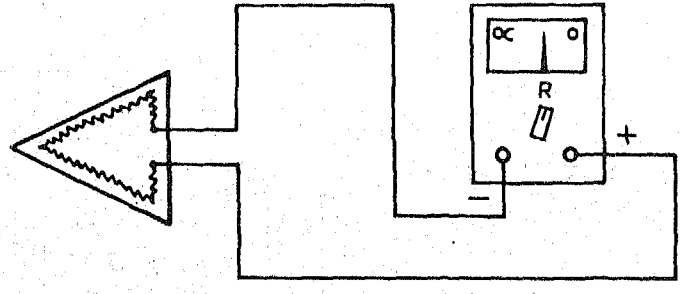


Fig.14.5 The reading shows some low value of resistance. This is the proof of continuity.

PRECAUTIONS

(i) Before connecting the multimeter always short the prods and see that the pointer goes to zero exactly. This is done by zero adjustment provided on the multimeter.

(ii) Select the proper meter and range. When you expect low value, select a lower range. However when high value of R is expected, select a higher range.

(iii) Avoid entangling of multimeter prods wires.

(iv) Do confirmation check by repeating the connection and keeping an eye on multimeter range and needle.

APPLICATIONS

A multimeter is a versatile instrument and has become indispensable. It does not require power supply for use. The O.C., S.C., leakage, earth and continuity can be conveniently checked by a multimeter when the appliance is not connected to supply.

Now a days digital multimeters are used for accuracy and quick work.

Activity No: 15 **Time Required: 2 Hours**

CALCULATION AND MEASUREMENT OF CURRENT OF HOUSEHOLD ELECTRICAL APPLIANCES

OBJECTIVE

(i) To calculate the working current of an appliance.

RELATED INFORMATION

Each appliance draws a certain fixed amount of *working* current at the designed voltage (220/230 Volt AC).

However, the starting current is always higher. The starting current flows only for a few seconds.

When a leakage/short circuit develops in an appliance, it draws an abnormal current. This abnormal current is an indication that the fault exist in the appliance.

TOOLS,EQUIPMENT AND MATERIALS REQUIRED

Equipment

(i)	Household appliance working at 220V	:	one
(ii)	Voltimeter 0–500V AC/DC	:	one
(iii)	Ammeter 0–10 amps AC/DC	:	one
(iv)	Tumbler switch 15 amps	:	one

Tools

(i)	Screw driver (10 cm)	:	one
(ii)	Insulated combination Pliers(15 cm)	:	one
(iii)	Neon tester	:	one

Materials

(i) 3/22 connecting wire 1 metre : 3 pieces

PROCEDURE

(A) Calculation of Current

The Wattage (W) in watts, current (I) in amps and voltage (V) in volts are related in the following way:

$W = V \times I$ Watts

or $I = \frac{W}{V}$ amperes

or $V = \frac{W}{I}$ Volts

Example (i): Calculate the working current of 100 W Lamp at 220 V.

Solutions : $I = \frac{W}{V}$ amperes

$I = \frac{100}{220}$ amperes = 0.454 ampere

Example (ii): Calculate the current drawn by an electric iron of 750 W working at 220 V.

Solution: $I = \frac{W}{V}$ amperes

$I = \frac{750}{220}$ amperes = 3.4 amperes

Example (iii): Find the current drawn by an immersion-rod (heater) of 1500 W working at 220 V.

Solution: $I = \frac{W}{V}$ amperes = 6.8 amperes

$I = \frac{1500}{220}$ amperes = 6.8 amperes

(B) Measurement of Current

Connect an ammeter in series with an electric iron. Connect also a switch and a 15 ampere fuse to a electric iron as shown in the Fig. 15.1. Now connect it to the mains, ensuring that the live wire is connected to the switch (off condition). This can be checked by means of a Line/Neon tester.

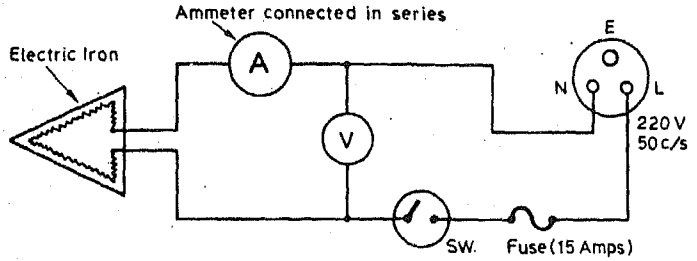


Fig.15.1 Measurement of current by Ammeter.

Put on the switch. Measure the current by reading the pointer position on the dial of the ammeter. This is the working current of the electric iron.

PRECAUTIONS

(i) Always connect the "fuse" and switch on the "Live" wire.

(ii) Always put the fuse preceding the switch.

(iii) Always connect the ammeter in series and voltmeter across the supply.

(iv) Make tight connections.

(v) Put off the switch immediately, if the current drawn is abnormal.

(vi) Avoid "nicking" of wire ends while removing the insulation.

APPLICATIONS

Whenever the appliance is working normally, it will draw a fixed amount of current at the rated voltage. However, when some defect is caused as leakage/short, it begins to draw abnormal current. This can be very useful so as to detect the defect in the appliance.

We can always cross check the current drawn in an appliance by calculation.

Activity No: 16 **Time Required: 2 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING ELECTRIC IRON

OBJECTIVES

To provide experience of

(i) Dismantling
(ii) Testing
(iii) Re-assembling an electric iron

RELATED INFORMATION

Electric iron is commonly used at home. Its repairs and maintenance will benefit students in their day-to-day work. Students may be told that electric iron works on the principle of heating effect of electricity. When electric current passes through a wire, it gets heated up. If the resistance is low, current is high and heating will also rise accordingly.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Tools

(i)	Insulated combination Pliers	:	one
(ii)	Screw drivers 20cm and 10 cm	:	one
(iii)	Spanner double ended	:	one set
(iv)	Test lamp	:	one

Material

(i)	Electric iron (ordinary)	:	one

Equipment

(i)	Multimeter (A VO meter)	one

PROCEDURE

An ordinary iron has following parts, which are to be

dismantled and re-assembled.

(i) Sole plate
(ii) Heating element
(iii) Cast iron plate or pressure plate
(iv) Iron cover
(v) Connecting socket with porcelain insulating washer
(vi) Cover
(vii) Insulated handle
(viii) Washers, bolt, end nuts for lightening the pressure plate and cover.

DISMANTLING

Dismantling of iron must be done step-by steps:

(i) Loosen the nuts from the bolts of electric iron.
(ii) Remove pressure plate after removing its bolts.
(iii) Remove the insulating handle and the cover (iron).
(iv) Finally remove asbestos from the base sole plate.

TESTING

Testing of element is done with the help of test lamp.

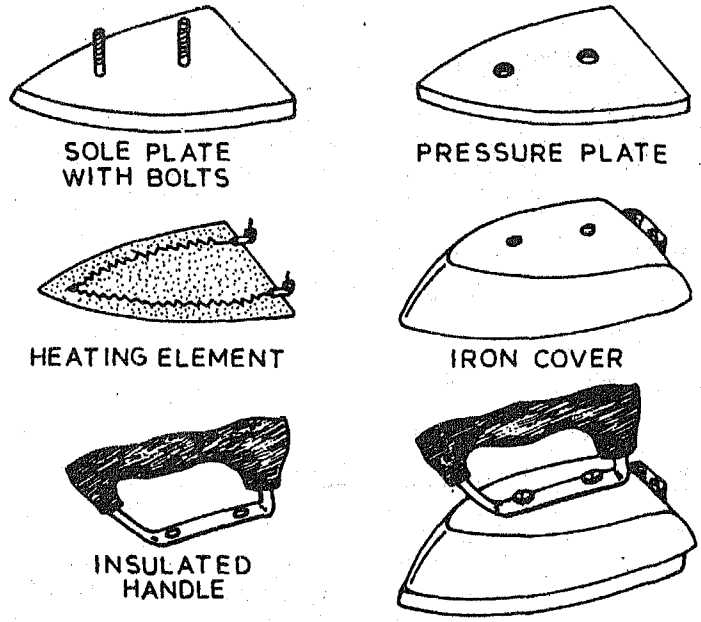


Fig. 16.1 Electric Iron

Two brass strips is connected to mains through test lamp. The test lamp will indicate the continuity of the heating element by the glow of lamp.

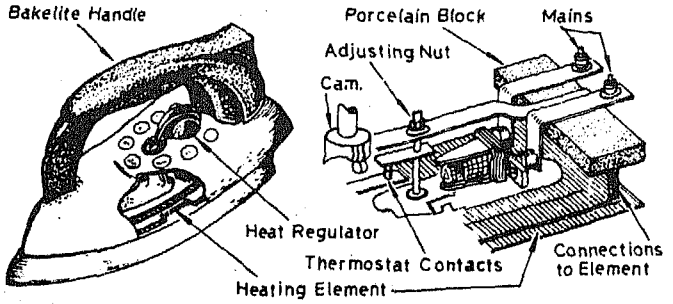


Fig. 16.2 Automatic Iron

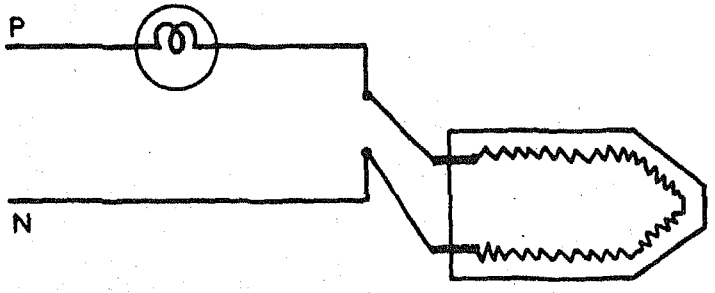


Fig.16.3 Continuity Test with a Test Lamp.

RE-ASSEMBLING

Re-assembling of electric iron is done just in the reverse method to dismantling:

(i) Sole plate studs must be tighten first.
(ii) Put asbestos sheet on base sole plate.
(iii) Assemble cover with the heating element and then place it on the sole plate.
(iv) Pressure plate must be placed on the heating element and tightened smoothly by nuts.
(v) Cover plate along with handle may be tightened at the end.

TESTING AFTER RE-ASSEMBLING

Check for continuity open circuit, short circuit, leakage and earth fault. If found correct, the electric iron is fit for use, but if there are some leakage or earthing defects, dismantle and check insulation. The Heating Element if found unfit for use must be replaced. Minor-repairs of heating element is also advisable.

PRECAUTIONS

(i) While unscrewing or tightening no undue pressure must be applied.

(ii) Equal pressure must be made while fitting the pressure plate.

(iii) Dismantled parts must be placed in a systematic way and the nut and screws must be secured in bins.

APPLICATION

Electric Iron is widely used in households for ironing clothes. Now-a-days the automatic iron and steam iron have widely come in use. In an automatic iron there is a thermostat which controls the heating of the iron. In steam iron water is used and heated.

Activity No: 17 **Time Required: 2 hours**

DISMANTLING, TESTING AND RE-ASSEMBLING IMMERSION HEATER

OBJECTIVE

(i) To develop skill for dismantling and re-assembling immersion heater

(ii) To develop skill for testing and minor repair of immersion heater.

RELATED INFORMATION

Immersion heater works on the principle of heating effects of electricity. In a immersion heater, a coiled rod is used in which there is an insulated element. Immersion heater is available in various capacities from 500 w to 2000 kw.

TOOLS, EQUIPMENT AND MATERIAL REQUIRED

Material

(i) Test lamp : one

(ii) Immersion heater 500watt 330 Volt : one

Tools

(i) Insulated combination pliers(15 cm) : one

(ii) Connector screw driver (10 cm) : one

PROCEDURE

Dismantling

(i) Unscrew the screws from the body of bakelite housing cover and remove the connecting cord from it.

(ii) Moulded shape of immersion heater may be unscrewed from the cover and placed gently on the bench.

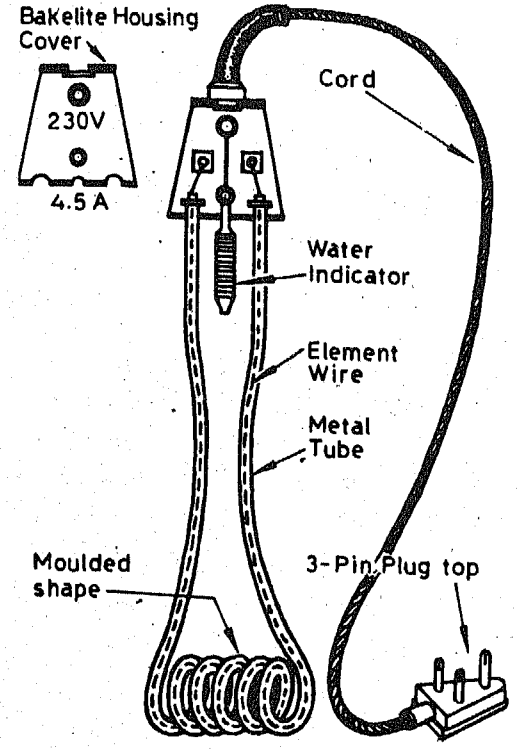


Fig. 17.1 Immersion Heater

Testing

(i) Connect two ends of the testing lead to the terminal of plug top of the immersion hater. If the lamp does not glow, it means there is an open circuit. Check each parts and make necessary replacements. If the lamp glows, it means the element of the heater is in working order.

(ii) Similarly earth fault may be tested by connecting one end of the testing lead to one terminal of plug top and another to the body of immersion heater (metal part of body) if the lamp glows it means there is an earth fault, i.e., the element is touching the body of the heater. If any spark occurs on the body, it means the insulation inside the element is leaking somewhere. In case of earth fault usually heater element and its housing parts are replaced.

Re-assembling

(i) Place the immersion heater element with the moulded shape cover on terminal housing and tighten the screws and nuts.

(ii) Connect the connecting cord to the terminals and make sure that the bakelite cover housing is properly screwed with lower terminal of housing and the water level indicator.

PRECAUTION

(i) Never give direct supply unless you are sure that there is no fault in the immersion heater.

(ii) All terminal connections must be properly tightened.

APPLICATION

Immersion heater is commonly used to heat water in a bucket.

Activity No : 18 **Time Required: 2 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING ELECTRIC KETTLE

OBJECTIVES

(i) To identify parts of electric kettle.
(ii) To develop skills of dismantling and reassembling electric kettle.
(iii) To develop skill of testing and minor repair of electric kettle.

RELATED INFORMATION

Electric kettle is used for warming water. It is available in two types, viz. immersion type and saucepan type. In the immersion type the heating element is in a coiled tube. The coil is placed in a container and two leads are provided at side for giving electrical connection. Earth terminal is connected to the metallic container. Leakage of water at the terminals is prevented by providing rubber sealing.

In saucepan type, heating element is similar to that used in electric iron but it is of circular shape. There are two portions in the kettle. The upper portion is a container of water. The lower portion houses the element. The leads of the heating element is connected to three-pin socket.

A three-core cable is used for connecting kettle to the supply.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Tools Required

(i) Insulated combination pliers 15 cm : one
(ii) Screw driver 8 cm, 15 cm : one each

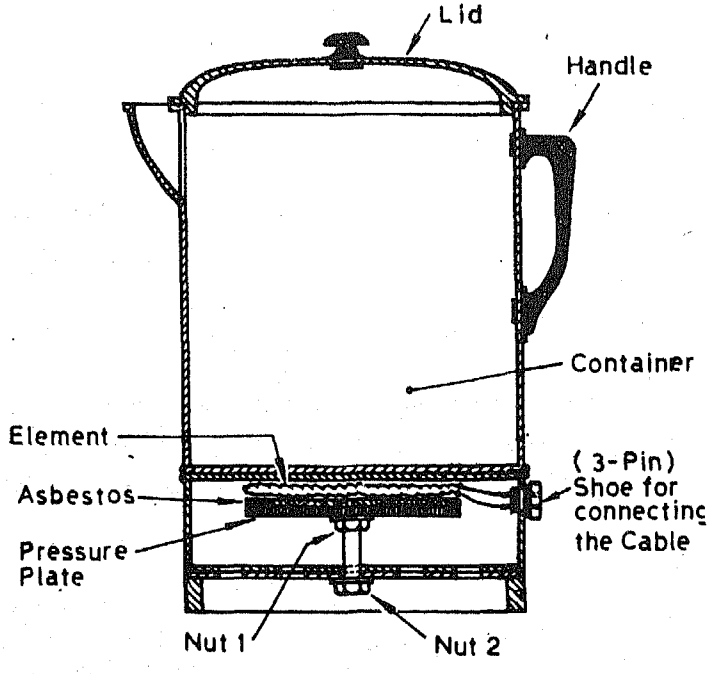


Fig. 18.1 Electric Kettle (Sause Pan type)

(iii) Adjustable spanner : one

Equipment Required

(i) Test lamp : one

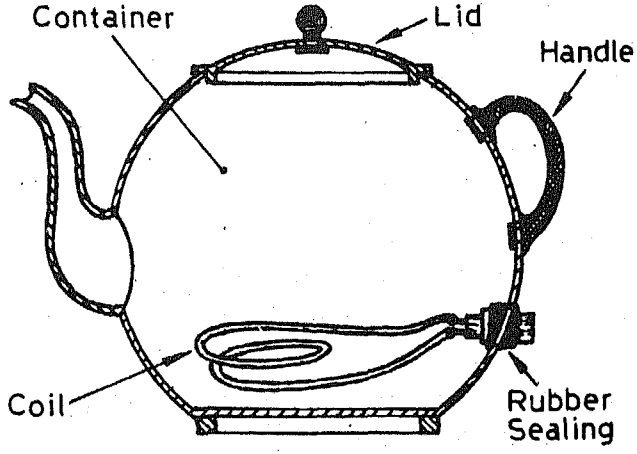


Fig. 18.2 Electric Kettle (Immersion type)

Materials Required

(i) Electric kettle 15 Watt, 230 Volt : one

(ii) Electric kettle 1000 Watt, 230 Volt : one

PROCEDURE

Dismantling (Saucepan Type)

(i) Remove the nut provided at the bottom of the kettle

(Fig. 18.1). Take out the lower cover after disconnecting the element from the 3-pin socket.

(ii) Remove the nut given on the pressure plate and take out the pressure plate, asbestos sheet and mica insulated element.

(iii) Keep all the parts separately.

Re-assembing (Saucepan Type)

(i) Keep the heating element by inverting the kettle.

(ii) Keep the asbestos sheet over the element holding the kettle in the same position.

(iii) Keep the pressure plate over the asbestos sheet and tighten nut No. 2 (Fig. 18.1).

(iv) Keep the lower cover and connect the terminals of the element to the socket.

(v) Keep the lower cover properly over the container and fix the nut No. 1 (Fig. 18.1). Now the kettle is assembled.

Testing

Test the kettle with the help of test lamp for (a) open circuit, (b) continuity, (c) earth fault/leakage.

(i) Connect the two leads of the test lamp to the supply.

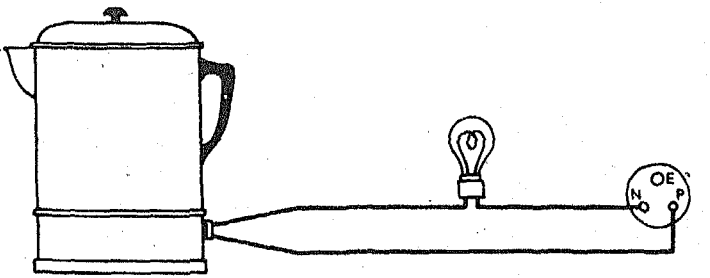


Fig. 18.3 Testing Kettle for Open Circuit. (Sause Pan type Kettle)

(ii) Switch on the supply. Touch the test leads to the two terminals of the coil. If the lamp glows it indicates a closed circuit. The coil is in good condition. If the

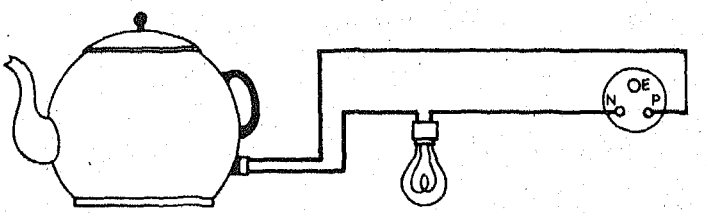


Fig. 18.4 Testing Kettle for Open Circuit. (Immersion type Kettle)

lamp fails to glow it means the coil is broken (open circuit). Replace the coil.

(iii) Place one test lead on the container and the other on one of the pins of the 3-pin socket. Change the lead on the pin and test it. If the lamp glows in any one position stated above, it means there is leakage or earth fault. Open the kettle and check for the insulation. Provide more insulation, if necessary.

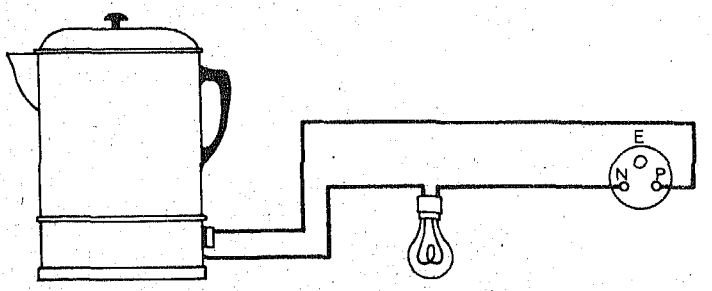


Fig.18.5 Testing Kettle for Leakage/Earth fault.

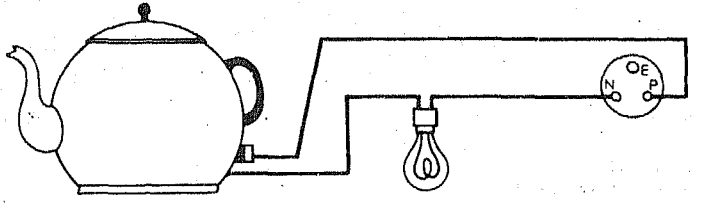


Fig.18.6 Testing Kettle for Leakage/Earth fault.

APPLICATION

The skill developed in this lesson may be applied to dismantle, assemble and test similar appliances.

Activity No. 19 **Time Required: 2 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING ROOM HEATER

OBJECTIVES

(i) To develop skill for dismantling and reassembling room heater.
(ii) To develop skill for testing and minor repair of room heater.

RELATED INFORMATION

Room heaters are normally used to heat the rooms during winter seasons. Room heater works on the principle of "Heating Effects of Electricity" and "radiation of heat". Concave mirror shaped steel is placed at the back of heating element for even distribution of heat.

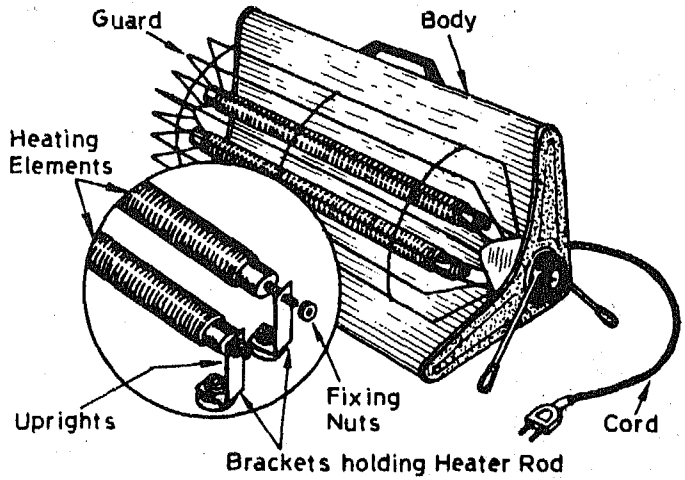


Fig.19.1 Room Heater

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Materials

i) Room heater 2 k.w. 230 Volt : one

Tools

(i) Test lamp : one
(ii) Insulated combination pliers 15 cms : one
(iii) Screw driver 8 cms, 14 cms : one each
(iv) Double ended spanner : one set

PROCEDURE

Dismantling

(i) Remove the wire gauge from the heater.
(ii) Take out the room heater element after unscrewing.
(iii) Disconnect the connections from the terminals.
(iv) Loosen the nuts and bolts of the back plate before disconnection is made.

Reassembling

(i) Connect the leads of connecting cord with the terminal and make sure that the control switch is connected properly.
(ii) Tighten the screws, nut and bolts of the back cover plate.
(iii) Place the heating element in position and tighten by nuts properly.
(iv) Check polish of the reflector.
(v) Place the protecting wire gauge in the groove provided or screw it to the body.

Testing

Test of room heater can be performed for:

(a) Open circuit test
(b) Short circuit test
(c) Leakage and earthing faults.

Connect the heater to the supply and switch on. Then connect the two leads of the test lamp to the terminals of the heater. If the lamp does not glow, it means that there is an open circuit, i.e., breakage in the element or disconnection of connecting wires at terminals.

If the lamp gives full light, it means there is a short circuit, i.e., both the connecting wires, inside the terminals are touching together. If the lamp gives dim light, the heater element is all right. For earth test, connect one terminal of the test lamp to one terminal of the heater and the other end

of the testing lead to the body of the heater. If the lamp glows, it means that there is an earth fault,. i.e., any part of the element or any connecting wire is touching the body. The other test may be made on cord, plug top or on connector if leakage or loose connections are found.

PRECAUTIONS

(i) Electric connection and other fitting must be properly secured.

(ii) Heating element (rod) should be handled carefully to avoid breakage.

(iii) Insulate yourself before testing.

(iv) Never give direct supply unless you are sure that there is no fault in the heater.

APPLICATION

Room heaters are specially used in Northern India where winter is severe. In order to save themselves from cold, room heaters are used by the people. Efficiency of heat radiation is increased by fitting polished reflectors to the heaters.

Activity No. 20

Time Required: 2 Hours

DISMANTLING, TESTING AND RE-ASSEMBLING TOASTER

OBJECTIVES

(i) To develop and provide experience in dismantling and re-assembling electric toaster.

(ii) To develop skill for testing and repair of toaster.

RELATED INFORMATION

Toaster is an appliance which works on the principle of heating effects of electricity. Toasters are available from 220 watts to 250 watts. Toasters are used for toasting bread. In a toaster, a coil used as heating element rapped on two mica sheets in a zig-zag way. Toasters are of two types. i) Manual type toster, ii) Automatic pop-up type toaster which works on an automatic time device.

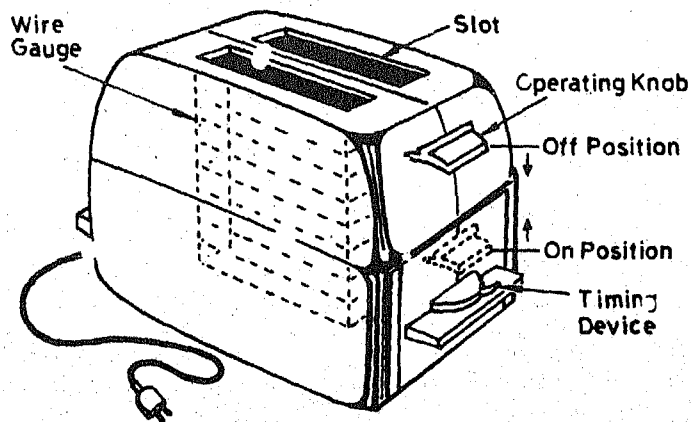


Fig. 20.1 Toaster

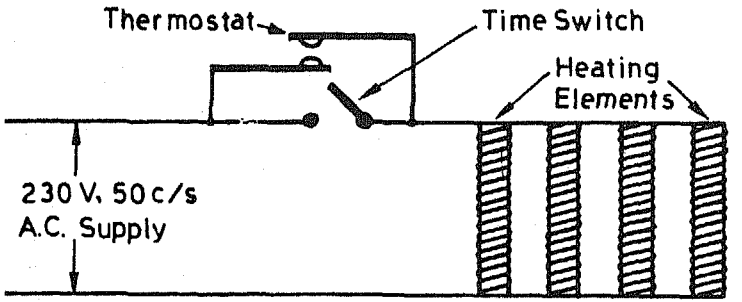


Fig. 20.2 Internal Connections Toaster.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

(i) Test lamp : one
(ii) Electric toaster 200 watt, 230 volt : one
(iii) Insulated combination pliers 15 cm. : one
(iv) Connecting screw driver 8 cm and 14 cm : one each
(v) Double end spanner : one set

PROCEDURE

A toaster consists of the following main features:

(i) Body (two parts) cover
(ii) Slot
(iii) Operating knob/lever
(iv) Timing device
(v) Base and toaster upright rest
(vi) Heating element and the wire gauge.

DISMANTLING

(i) Dismantling of electric toaster is done by opening the body covers after disconnecting the appliance from the supply.
(ii) Remove the terminals connecting the two sets of heating elements from the terminals (connector) and check the arrangement of element on mica sheets.
(iii) Release the spring controlling lever used to pull up or down the toaster. By removing the screws this arrangement can be dismantled, but it should be avoided.
(iv) Time device connection may be studied, and no dismantling is usually done.

RE-ASSEMBLING

(i) Insert the two sets of element outside the wire gauge in the housings and connect the two sets of heating

element with terminals (connector).

(ii) Close the two body covers together with screws, nuts and bolts.

(iii) If time-device has been opened, put the adjusting spring in order and check the lever for lifting or lowering the toaster, before closing the body part.

TESTING AND MAINTENANCE

Continuity and short circuit

(i) Connect the testing leads to the two ends of the element. If the lamp gives dim light, there is continuity. If the lamp does not glow, it is an open circuit. If the lamp gives full light, there is short circuit.

(ii) In case of open circuit, connect the broken ends. In case of short circuit, separate the touching ends and insulate them with porcelain beads.

Earth test

Connect one testing lead to any one terminal of the toaster and the other testing lead to the body of toaster. If the lamp glows, it is an earth fault.

Repairs : Separate the touching end from the body and insulate it with porcelain beads. Continuity test of the cord should also be done. Open circuit wherever seen, may be rectified and if required replace defective component. Similarly testing of terminal connection is done and made in working order.

PRECAUTIONS

(i) Fittings should be properly tight.

(ii) Insulate yourself before testing.

(iii) Never give direct supply unless you are sure that there is no fault in the toaster.

(iv) Test the toaster with a test lamp.

(v) Toaster lifting lever may be lubricated but it should not be oiled too much.

APPLICATION

Electric toaster is one of the most widely used electrical appliances. This is used to toast bread slices. Manual or automatic toaster is made use for quick toasting purposes. It saves time of housewives. It becomes economical if large number of toasts are to be toasted simultaneously one after the other. Electric toaster is a simple form of appliance which needs little care to handle.

Activity No. 21 **Time Required: 2 Hours**

DISMANTLING,TESTING AND RE-ASSEMBLING ELECTRIC HOT PLATE

OBJECTIVES

(i) To develop skill for dismantling and reassembling electric hot plate.

(ii) To develop skill for testing and minor repairs of electric hot plate.

RELATED INFORMATION

Electric hot plate is widely used for cooking. It is safer than an Electric Stove. It lasts for a longer period than any other cooking appliance. It consists of a nichrome coiled element housed in a metallic frame. Three-pin socket is provided on the frame. The terminals of the element and pins of socket are connected by thick conductor. The whole assembly is covered by a bottom cover plate. A rotatory switch controls low, medium and high temperature. Electric hot plates are usually available in 500, 1000,1500 watts at 230 volts. It works on the principle of "Heating Effects of Electricity"

TOOLS AND EQUIPMENT REQUIRED

(i)	Test lamp	:	one
(ii)	Insulated combination pliers 15 cm	:	one
(iii)	Insulated screw driver 15 cm	:	one
(iv)	Insulated screw driver 8 cm	:	one
(v)	Knife	:	one

MATERIALS REQUIRED

(i) Electric hot plate 500 W, 1000 W: 1500 W:one each.

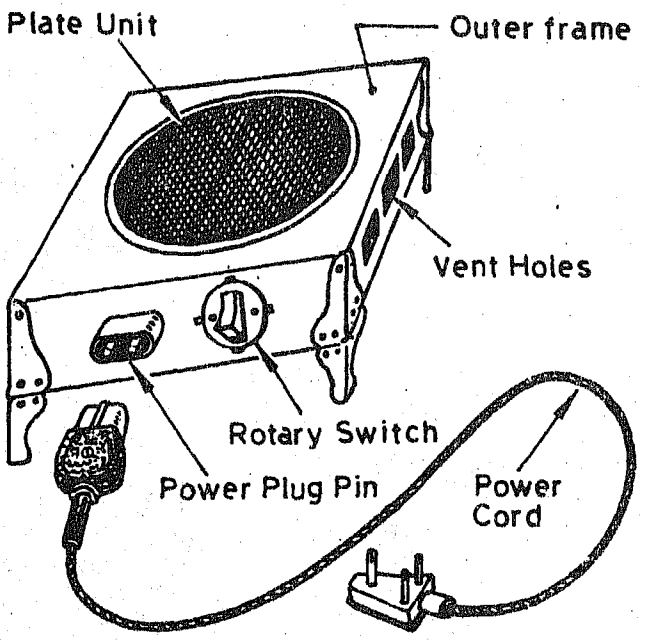


Fig. 21.1 Electric Hot Plate.

DISMANTLING

(i) Disconnect the power cord from the mains and remove it from the power plug socket.

(ii) Open the bottom cover plate and unscrew the plate unit from socket and rotary switch.

(iii) Study plate unit by checking spirally wound heating element embedded in a groove of the base.

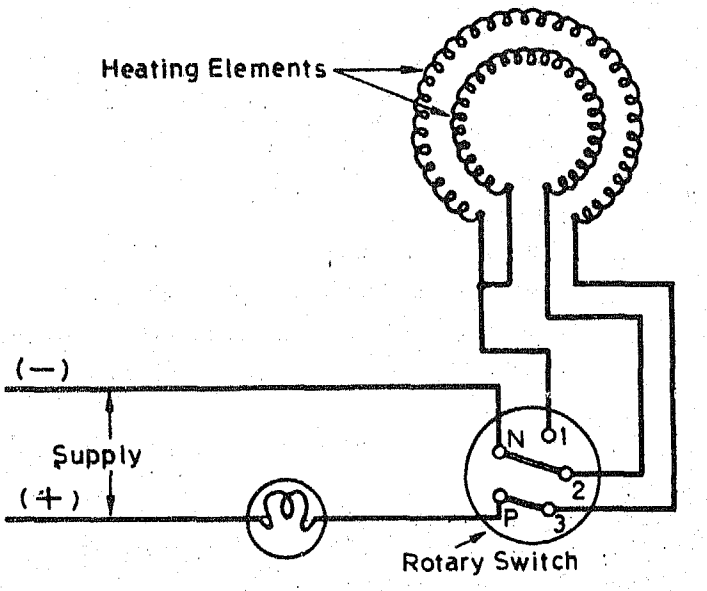


Fig. 21.2 Testing Heating Element.

(iv) Plate unit top made of alloy of cast iron, and placed

over the grooved porcelain base may not be removed but its construction and position can be carefully observed.

RE-ASSEMBLING

(i) Place the plate unit on the grooves, provide and clamp it with the nut and bolt keeping terminals of the element towards the rotary switch.

(ii) Connect the terminals of heating element, one by one.

(iii) Cover with the bottom cover plate by screwing the screws. Connect the two ends of the testing lead to the terminal of plug top of the hot plate. If the lamp does not glow, it means there is an open circuit, i.e.

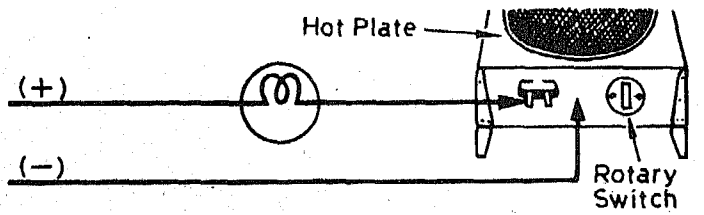


Fig. 21.3 Checking Earthing or Leakage.

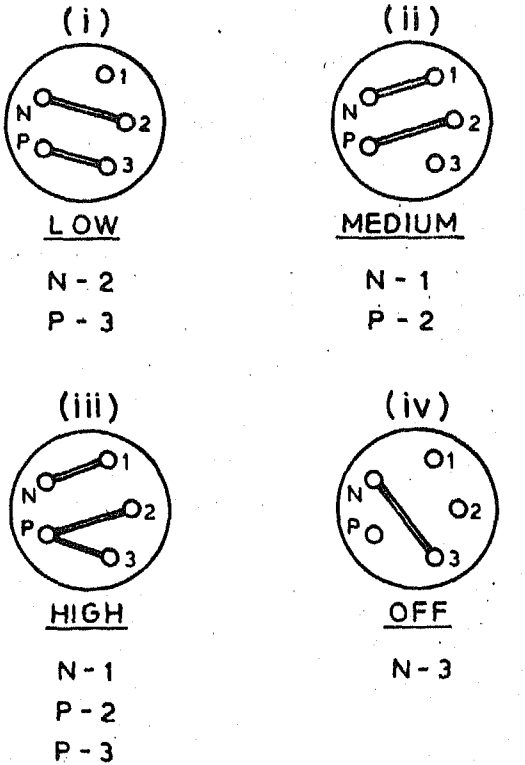


Fig. 21.4 Switch Positions.

breakage of element inside the plate unit, check continuity and make necessary repair.

For earth and leakage test, connect two ends of testing lamp with power plug pin and body of electric hot plate. If the lamp glows, it indicates earth/leakage fault. Earth/ leakage fault may be present in terminal leads, heating elements, and hot plate body.

PRECAUTION

Never start dismantling an appliance when it is connected with the mains.

APPLICATION

Electric hot plates are usually used in hospitals and kitchens where there is need to avoid smoke, and dirt. Therefore they are used in sterilization of instruments, for general heating and cooking purposes. It is a costly appliance but has several advantages. It has high, low and medium controls to control the temperature.

Activity No.22 **Time Required: 2 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING GEYSER

OBJECTIVES

(i) To provide work experience in dismantling and re-assembling an electric geyser.

(ii) To develop skill of testing and minor repairs of electric geyser.

RELATED INFORMATION

Electric geysers are used to heat water. These are generally available in 5 litre to 20 litre capacity tank and of 1000 watts to 3000 watts rating.

It works on the principle of "Heating Effects of Electricity" and has a thermostat, stopcock, heating element, inlet and outlet pipes fitted in the double-walled body. The geyser is fitted on the wall of a bathroom at a suitable height. Cold water enters through inlet pipe and comes out through outlet pipe. Outlet flow of water is controlled with the help of stopcock. Terminals of heating element are brought out at the base. A red indicator is provided on the geyser which glows when the electricity supply to the geyser is on.

The geysers are of three types: storage water heater, portable geyser and instant water heater. They are made use of according to their nature.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

(i) Test lamp 230 V with testing leads : one

(ii) Electric geyser 1000 W, 230 V : one

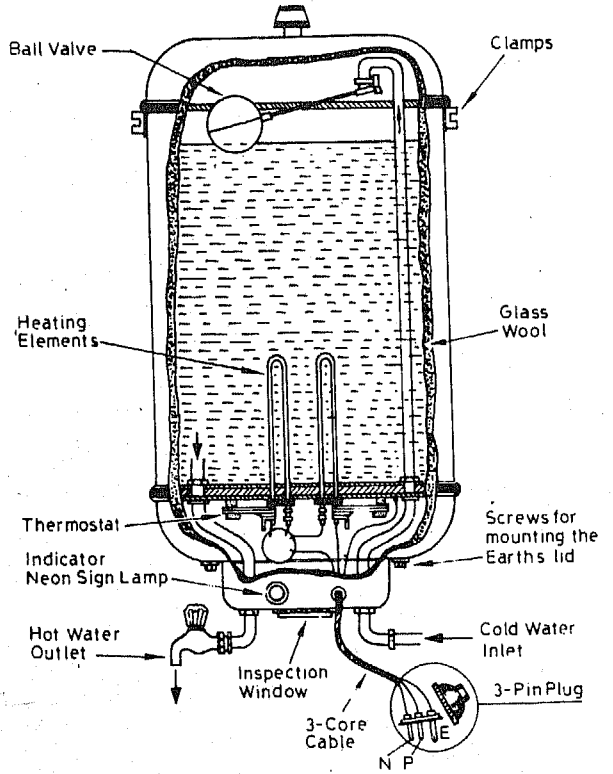


Fig. 22.1 Geyser

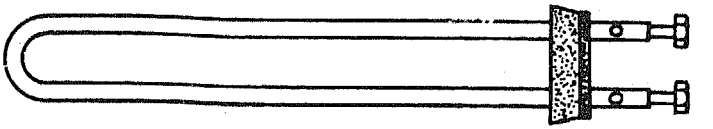


Fig. 22.2 Heating Element.

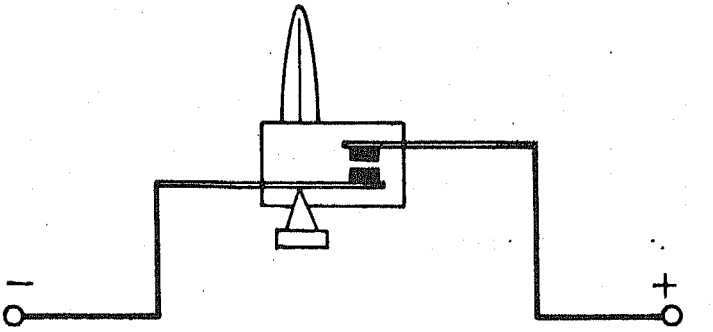


Fig. 22.3 Thermostat.

(iii) Insulated combination pliers 15 cm : one

(iv) Connecting screw driver 8 cm and 14 cm : one each

(v) Pipe wrench 20 cm and 30 cm : one each
(vi) Thread and white hard paint (safeda)
(vii) Liquid thinner : 250 ml

PROCEDURE

A geyser has the following main parts:

(i) Metallic double-wall tank (between the walls thermal insulation of glass wool is provided)
(ii) Heating element
(iii) Thermostat
(iv) Water pipes inlet and outlet
(v) Stopcock
(vi) Inspection window.

These parts are made for the specific job so that the geyser works in proper way.

DISMANTLING AND RE-ASSEMBLING

(i) Procure all the tools and materials. Observe the fittings and parts of geyser as shown in Fig. 22.1.
(ii) Unscrew the screws of inspection window and remove the plate.
(iii) Check the connections and disconnect the indicator lamp.
(iv) Heating element, thermostat, delivery tube, thermostatic switches are mounted on the lid. Remove these parts and inspect their construction.
(v) Remove the lid of the geyser gasket.
(vi) Check water tank physically; remove if any scale has been formed inside the tank.
(vii) Check the connecting wires and see that connections are tight. Avoid loose connections. Replace defective connecting terminals, and connecting wires.
(viii) Tighten the thermostat, delivery tubes very carefully.
(ix) Remove the rust (if any) on any part of the geyser and apply paint, if possible.
(x) Fit the gasket and place the lid on the geyser. Tighten the nuts accordingly.
(xi) Conduct electrical tests.

TESTING OF GEYSER

(i) *Continuity and short circuit*: Connect the testing leads to the two ends of the element.If the lamp gives dim light, there is continuity. If the lamp does not glow, it shows an open circuit fault in the

element of the geyser. If the lamp gives full light, there is a short circuit in the element. Elements found defective must be replaced and fitted after testing continuity.

(ii) In case of open circuit, connect the broken ends in case of short circuit, separate the touching ends and insulate them with a suitable separator or porcelain beads.

(iii) *Earth test*: Connect one of the testing leads to any one terminal of the geyser and the other testing lead to the body of the geyser. If the lamp glows, there is earth fault in the geyser. Locate the wires touching the body.

REPAIRS

Separate the touching ends from the body and insulate the touching end with the insulating paper or porcelain beads. Continuity test of the cord can also be done with the help of a test lamp. Worn out cords may be replaced and the plug and socket (connector) connections can be tightened. It need not be replaced. Similarly the working of thermostat can be checked with the generation of heat. If it does not operate, replace it.

PRECAUTIONS

(i) Before switching on the geyser ensure that the inlet water supply is open to the geyser.

(ii) In case of instant water heater, avoid using hard water as this water contains mineral salts.

(iii) The feeder wire should be of proper size and of copper.

(iv) Test the geyser in series with the supply.

(v) Parts which need lubrication must be lubricated with oil or grease periodically.

(vi) Insulate yourself before testing.

(vii) All connections, terminals and nut and bolts must be tightened properly.

APPLICATION

Electric geyser is used for warming water. It is useful in bathrooms, kitchens and hospitals, where hot water supply is always required. The geyser should be mounted in such a position that cold water supply is near and can be connected with the G.I. Pipe.

Activity No. 23 **Time Required: 2 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING ELECTRIC BUZZER/CHYME

OBJECTIVES

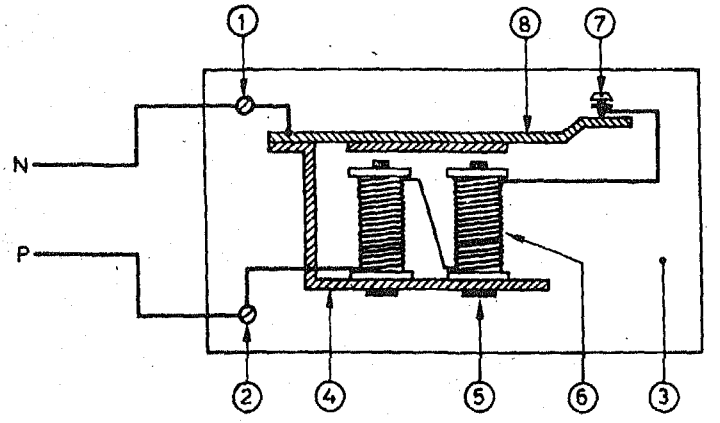
(i) To acquaint the students with operational principles of electric buzzer.
(ii) To dismantle parts of electric buzzer.
(iii) To examine various parts of electric buzzer.
(iv) To detect faults in electric buzzer.
(v) To reassemble electric buzzer.
(vi) To connect electric buzzer to supply.

RELATED INFORMATION

This is a very common electric device used in almost every home. It is used to call or draw attention by making certain amount of low noise.

Electric buzzer works on the principle of electromagnetism. It consists of parts; such as solenoid coil, vibrating contact strip, base, soft iron core and adjustable screw. For the details of parts refer to Fig. 23.1.

When the electric circuit is made 'ON' by pressing the push button, current flows through the solenoid coil and vibrating contact strip. This sets up a magnetic field about the solenoid coil and the contact strip is attracted towards the coils. At the same time, the circuit is broken. The break in circuit cuts 'OFF' the magnetic field and allows the contact strip to go back to its original position and resume the contact. The cycle is repeated rapidly and continuously until the pressure on the push button ceases. Thus the vibrating contact strip vibrates and causes buzzing noise.



① Neutral
② Phase
③ Base
④ Iron Frame
⑤ Soft Iron Core
⑥ Solenoid Core
⑦ Adjustable Screw
⑧ Vibrating Contact Strip

Fig. 23.1 Parts of Electric Buzzer.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

(i) Insulated combination pliers 15 cm : one
(ii) Connector screw driver 8 cm : one
(iii) Electric buzzer : one
(iv) Test lamp : one

PROCEDURE

Dismantling

(i) Unscrew the screws of the buzzer cover and remove the cover.
(ii) Disconnect all electrical connections from the buzzer.
(iii) Unscrew the screws of solenoid coil and remove the same from base.
(iv) Unscrew the screws and remove vibrating strip from base.

DEFECTS AND TESTING

There may be open circuit in the solenoid coil. To find out this, connect solenoid coil to the test lamp as per Fig. 23.2. If the lamp does not glow, in that case the coil must have been burnt or broken. If lamp glows, in that case coil is in order. No sound from buzzer indicates there may not be supply or there must be loose connections in the terminals

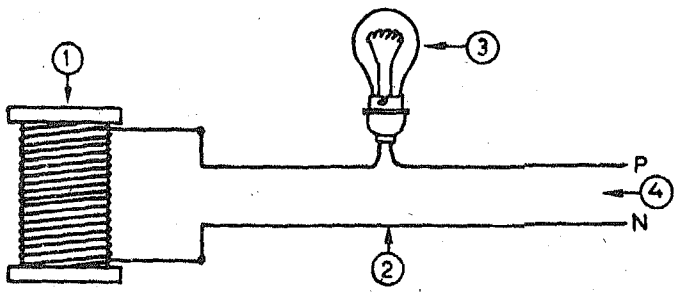


Fig. 23.2 Testing of Solenoid Coil.

of buzzer. So check the supply and tighten all the terminal screws of the electric buzzer.

Adjustments

When there is no proper noise or vibration at contact strip, adjust the adjustable screw. If the screw is unscrewed enough to leave a gap in between contact points, no current can flow and vibrator strip will not vibrate. On the other hand, if the adjustable screw is screwed too far, the contact will not part when the contact point is drawn towards solenoid coil, and will remain jammed. The adjustable screw should be adjusted while the push button is being pressed to a position between two extremes to give most satisfactory sound.

Reassembling

(i) Place a solenoid coil on the base and screw to the base.

(ii) Place vibrating contact strip and fix the same on base plate with screws.

(iii) Connect intermitent wires to various terminals properly as per diagram shown in Fig. 23.1.

(iv) Connect the buzzer to suppply and observe the function.

(v) If there is no satisfactory sound, adjust the adjustable screw keeping push button pressed.

(vi) Fix the electric buzzer cover with the help of screws.

PRECAUTIONS

(i) Solenoid coils should be connected in series.

(ii) Rusted points should be cleaned with sand paper.

(iii) Test solenoid coil always with series test lamp.

APPLICATIONS

(i) Commonly used in domestic and commercial buildings.

(ii) Used as specific type of indicator in certain cases as alarm.

ACTIVITY No. 24

Time Required : 2 Hours

DISMANTLING, TESTING AND RE-ASSEMBLING FLUORESCENT TUBE FITTING

OBJECTIVES

(i) To acquaint the student with the operational principles of a fluorescent tube.
(ii) To dismantle and test the faults of various compo nents of fluorescent tube.
(iii) To reassemble the components of fluorescent tube.
(iv) To connect the tube to the supply.

RELATED INFORMATION

Fluorescent tube consists of a glass tube fitted with two filaments at its end. Mercury and orgon gas at low pressure are filled in the glass tube. The inside of the tube is coated with fluorescent material which helps to produce brighter illumination than tungsten filament having same power consumption.

The low pressure gas tube requires an initial high voltage to allow a conduction path. Single phase voltage supply having 230 volt is not sufficient to ignite these tubes. For this purpose a starting element known as starter and choke coils are used. These two units help to produce enough high voltage across the electrodes to make low pressure gas conductive. Once the gas begins conducting, the conduction is sustained at the normal supply voltage (220v/230v).

The main accessories connected with lamp are: (a) starter (b) choke coil.

Starter: It is a small cathode glow lamp with metal strip as

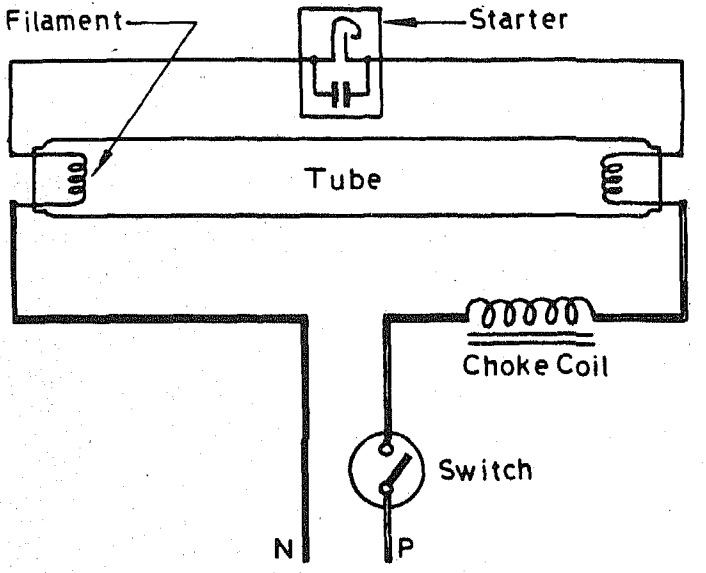


Fig. 24.1 Circuit for Fluorescent Tube Connections.

electrode. It completes a series circuit of tube, choke, starter, and supply first. Then opens and interrupts the current in the circuit and there induces surge voltage of 1000 volts to start the tube. A push button instead of starter can be used but that will not be automatic. This method is not convenient.

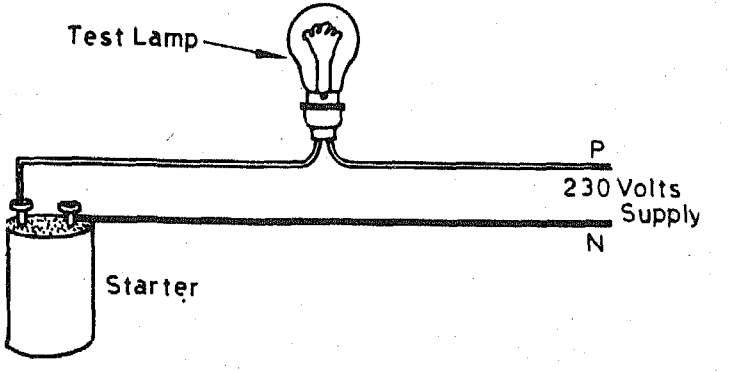


Fig. 24.2 Testing of Fluorescent Lamp Starter.

Choke coil: It is also called as ballast. It consists of a laminated core over which enamelled wire is wound. The function of the choke is to increase the voltage to almost 1000 volts at the time of switching on the tube and when the tube starts working it decreases the voltage across the

tube and keeps the current constant. AC and DC tube lights are available. Normally tubes are available in the ranges of 20 watts and 40 watts.

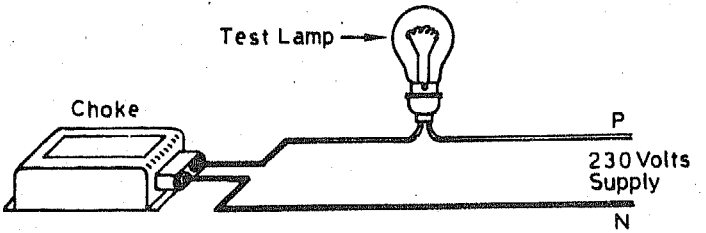


Fig. 24.3 Testing of Choke Coil by Test Lamp.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

(i)	Insulated Combination pliers 15 cm	:	one
(ii)	Screw connector driver 8 cm	:	one
(iii)	Test lamp with leads	:	one
(iv)	Complete fluorescent tube light (40 watts)	:	one

PROCEDURE

Dismantling

(i) Rotate the tube from rotor tube holder and remove tube from set.

(ii) Disconnect the terminals of choke.

(iii) Loosen the screws of choke and take out the choke.

(iv) Remove the starter from starter holder.

Defects and Testing

i) A Lamp may not glow: It is possible because there must be loose contact at rotor tube holder. Check this by test lamp putting a test lamp across the two contact points of rotor tube holder. There may be another reason that gas might have leaked out of lamp. Otherwise choke must be defective or filament of tube lamp may be broken. For testing of filament refer to Fig. 24.4.

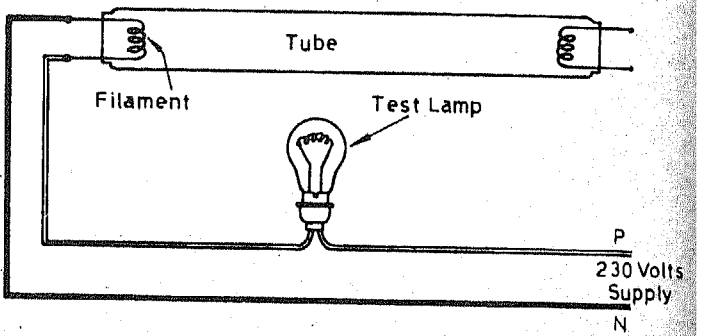


Fig. 24.4 Testing of Filament of Fluorescent Tube.

Connect the test lamp to the terminals of one end of tube. If lamp glows,then the filament is in good condition. If the lamp does not glow, in that case filament must be broken. If the lamp gives 50 per cent light and the same end of tube gives little light, then this end of the tube is either weak or defective. A defective tube should be replaced by a new one.

For testing of choke refer to Fig. 24.4. Connect a 40 watts lamp in test lamp holder and connect the supply through test lamp to choke terminals. If the lamp gives 50 per cent of light or more then the choke is in good condition. If the choke is burnt out, then the lamp will either give full light or will not glow at all.

A full light of lamp indicates a short circuit in the winding and no light indicates an open circuit. An open or short circuited choke must be replaced.

(ii)*Filament glows but the whole tube does not give light*: This is possible due to defective starter. To test the starter refer Fig. 24.3. Connect the test lamp as per figure. If the lamp glows intermittently slow or fast (twinkle) the starter is in good condition. If the test lamp either gives full light or does not give any light, then the starter is defective. Defective starter must be replaced.

(iii)*Tube twinkling*: It is possible that life of the tube is over. Supply voltage may be too low or starter may be defective.

(iv) *Gas is whirling inside the tube*: This phenomenon occurs with new tube. To rectify this switch off the light for a while and then switch on again.

(v) *It take more time for the tube to give light :* It is Possible that voltage be too low, starter or choke may be defective. Check starter and choke by test lamp. Replace choke or starter if they are defective.

(vi) *Electrodes gets burnt when the tube is switched on*: Wrong wiring or choke may not be in the circuit. Connect wiring as per circuit diagram in Fig.24.1 and correct the same.

(vii) *Tube life is less* : It is possible because of more voltage supply. Check the voltage. It should be at the range of 220 volts.

(viii) *Tube lights twinkles and ends are black:* Tube light's life is over. In this case, change the tube.

(ix) *The tube light gives small light at night even after switching 'OFF'*: It is possible that phase wire is directly

connected to tube and it is not through the switch. Check the polarity of switch by test lamp. If this is the case, put supply through the switch to the tube light.

Re-assembling

(i) Put all the accessories like rotor, tube holder, starter and choke on the tube base strip.
(ii) Tighten all the nuts and bolts.
(iii) Connect all components by means of wires as per the circuit diagram in Fig. 24.1.
(iv) Give supply to the tube set and observe the working.

PRECAUTIONS

(i) Fittings should be tightened enough for rigidity.
(ii) The choke should always be connected in series and the capacitor should always be connected in parallel.
(iii) The starter should always be across the fluorescent tube.

APPLICATION

(i) Used for domestic, industrial and street lighting purpose.
(ii) As it works at low temperature compared to other lamps, it is used in places where air conditioning is done.

Activity No. 25 **Time Required: 3 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING CEILING FAN

OBJECTIVES

(i) To test and connect a ceiling fan.
(ii) To know different types of locking arrangements from the safety point of view.
(iii) To select a ceiling fan for a particular room.
(iv) To know detailed information from a fan name plate.

RELATED INFORMATION

Before handling a ceiling fan the students should know the details of a particular fan. The information is available from a name plate which is fixed on the body of a fan.

Name Plate of a Ceiling Fan 48" Sweep

MAKE	: NAME OF THE MANUFACTURER
SIZE	: 48" (120 mm)
VOLTS	: 220/230 VOLTS A.C.
FREQUENCY	: 50 c/s
WATTS	: 90W
WEIGHT	: Weight in Kg
MADE IN INDIA	: ADDRESS

Informations on name plate helps us to use the appliance properly. In general, most ceiling fans have a capacitor start single phase induction motor with a difference from usual

motors that its central portion (rotor/armature) remains fixed, while the outer portion (stator) rotates. Blades are mounted on the outer portion of the fans. The capacitor is used for giving a starting torque to the fan. Electric fan is mounted over a shaft. When the motor is energised, the outer portion makes the blades to rotate and to circulate the surrounding air. The movement of the surrounding air depends upon the speed of the fan. A regulator is connected in series with the fan with different tappings. The speed of a fan can be controlled by a regulator. A fan consists of number of parts. All the parts are fixed together on a shaft. To avoid loose fittings, the parts are locked with bolts, check nuts, split pins and bearing locks.

MATERIALS REQUIRED

(i)	Ceiling fan 220 Volts, 120 mm	:	one
(ii)	PVC insulation tape	:	one roll
(iii)	Spindle oil/mobile oil with oil can		
(iv)	Grease for bearings		
(v)	Duster cloth		
(vi)	Kerosene oil 200 ml		
(vii)	Wooden plank 2′–0″×3′–0″×½″	:	one

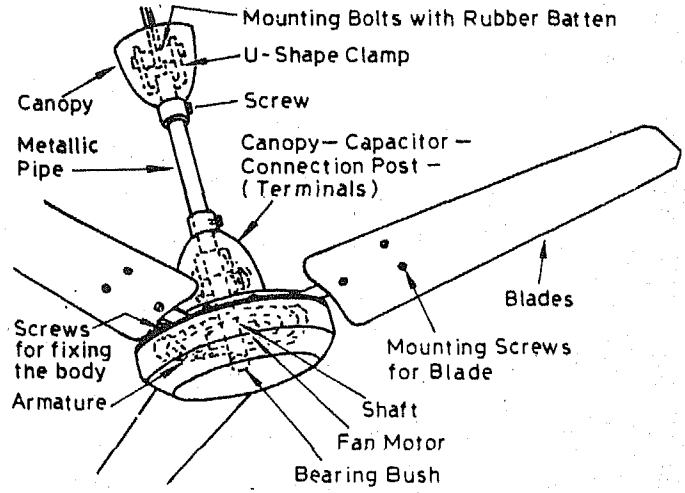


Fig. 25.1 Different parts of a Ceiling Fan.

TOOLS REQUIRED

(i)	Insulated combination pliers 20 cm	:	one
(ii)	Insulated screw driver (connector)	:	one
(iii)	Insulated screw driver 15 cm	:	one
(iv)	Insulated screw driver 25 cm	:	one
(v)	Test lamp 60 Watts 230 Volts	:	one
(vi)	Bearing puller	:	one

PROCEDURE

(i) Collect tools and materials.

(ii) Hold the fan in one hand and rotate the blades. Check if it gives any sound. Sound means bearing/ bush is defective or loose.

(iii) Remove the condenser from its housing.

(iv) Disconnect connecting wires of the fan.

(v) Test in series with the test lamp between conductors. If it gives dim light, then winding is alright.

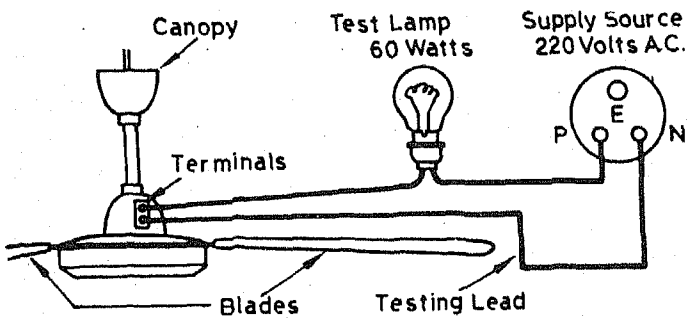


Fig. 25.2 Continuity, Open, Short Circuit Test of a Ceiling Fan between Conductors.

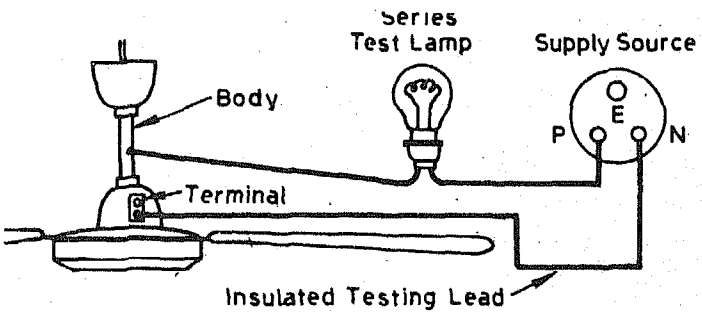


Fig. 25.3 Testing of Earth and Leakage between Conductors and body of a Fan.

(vi) Test in series with the body of the fan. If it gives no light, there is no earth fault and no leakage.

(vii) Test the capacitor in series with series test lamp. As soon as testing leads are connected to the capacitor, the lamp glows and the capacitor gets charged. Remove the test leads from the capacitor Short the capacitor's terminals by means of a wire. If any spark develops, it means that the capacitor is alright.

(viii) See the fan carefully and observe its screws, bolts etc.

(ix) Remove the capacitor, disconnect the wires from the terminals.

(x) Remove any lock (split pin, check nut, etc.)

(xi) Unscrew the motor screw and blades' screws.

(xii) Remove the blades and the bottom cover of the motor.

(xiii) Remove the bearing/bush from the shaft with the help of bearing puller.

(xiv) Remove the armature and top cover of the motor.

(xv) Remove the bearing/bush from the shaft.

(xvi) *Clean the bush/bearing with kerosene oil.*

(xvii) Fit the bush/bearing into the shaft.

(xviii) Put oil/grease in bush/bearing.

(xix) Assemble all the parts of the ceiling fan.

(xx) Fix all the screws, locks, nuts, etc., tightly.

(xxi) Mount the fan on its respective place and fix the blades. Make connection of the fan to the supply.

PRECAUTIONS

(i) While dismantling, assembling and testing a ceiling fan, keep it on a wooden blank or rubber mat.

(ii) Keep all the screws, bolts, locks, nuts, etc. in a box/tray during dismantling.

(iii) Fix all the screws, bolts, locks and nuts properly during assembling.

(iv) Do not lubricate the bush with grease. Always put good grease in ball bearing and mobile oil in the bush.

(v) Handle the fan's blades gently otherwise the blades will be disbalanced and may damage the fan motor, bearings, bush, etc.

Activity No. 26 **Time Required: 5 Hours**

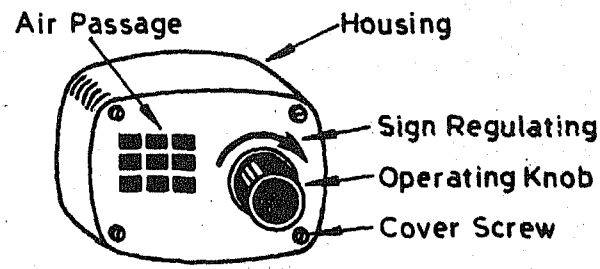
DISMANTLING, TESTING AND RE-ASSEMBLING CEILING FAN REGULATOR

OBJECTIVES

(i) To test and connect a fan regulator with a ceiling fan.
(ii) To dismantle and assemble a fan regulator
(iii) To identify different parts of a fan regulator.

RELATED INFORMATION

A speed regulator provided with a ceiling fan is generally a resistance in steps with different tappings. Voltage supplied to the fan through the regulator operates the fan at different speeds. It is a device connected in series with a fan to control the speed.



SOLID STATE (ELECTRONICS) REGULATOR

Different parts of a fan regulator are:

(i) Operating knob
(ii) Tapping plates
(iii) Top cover
(iv) Base plate

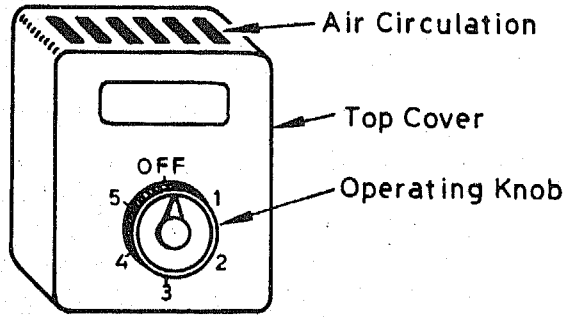


Fig.26.1 Overview of a Fan Regulator.

') Wire wound resistance mounted on the base keeping a space with the base

i) Connection from wire wound resistance to the plates

ii) Sector switch

iii) Connecting terminals.

ATERIALS REQUIRED

) Solder wire	:	10 gms.
i) Solder Paste	:	5 gms.

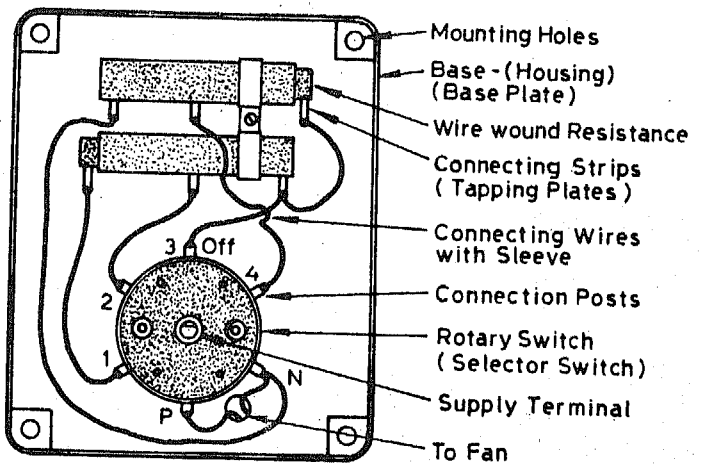


Fig.26.2 Parts of a Fan Regulator

(iii)	Empire sleeve 2 mm	:	30 cm
(iv)	Copper wire 24 swg	:	60 m
(v)	Fan regulator	:	one

TOOLS REQUIRED

(i)	Insulated combination pliers 20 cms	:	one
(ii)	Insulated screw driver (Connector)	:	one
(iii)	Insulated screw driver 15 cms	:	one

(iv)	Insulated screw driver 25 cms	:	one
(v)	Knife	:	one
(vi)	Soldering iron 25 W, 230 V	:	one
(vii)	Soldering iron stand	:	one
(viii)	Scissor 20 cms	:	one
(ix)	Flat nose pliers 15 cms	:	one
(x)	Series test lamp 60 watts 230 V	:	one

PROCEDURE

(i) Procure the required materials and tools.

(ii) Unscrew the operating knob and remove it from the selector switch.

(iii) Open the top cover.

(iv) See the inner part of the regulator and observe the mounting of the parts.

(v) Check the continuity of the resistance.

(vi) Check operation of regulator switch.

(vii) Connect the series test lamp with the terminals of regulator and main supply as per circuit given in Fig. 26.3. If lamp shows dim light on 1, 2, 3, 4, and full light on 'ON' and no light on 'OFF', it means regulator is alright.

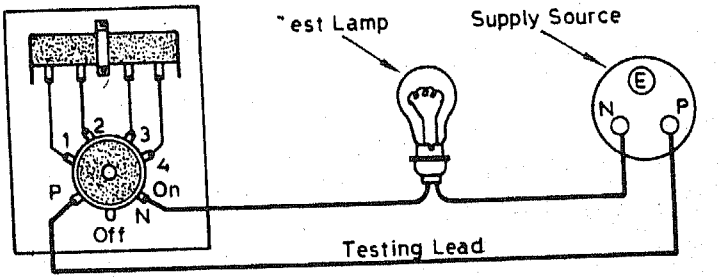


Fig. 26.3 Continuity Test.

(viii) Check the earth and leakage fault of the switch and resistance with the body. Connect the testing lead as shown in Fig. 26.4. Observe light of the lamp. If lamp does not glow there is no earth fault.

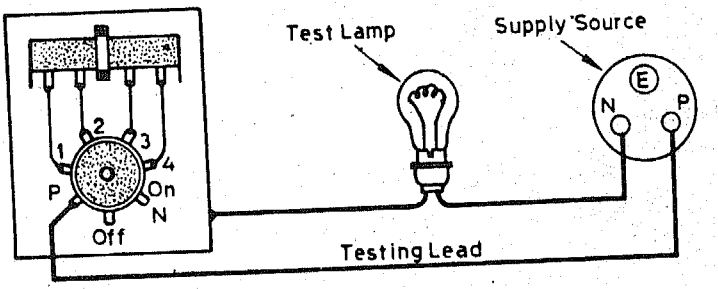


Fig. 26.4 Leakage Test.

(ix) Connect the resistance terminal with the terminal of selector switch with the help of wire and sleeve.

(x) Solder all connections with the help of soldering iron. Before soldering,the connection points should be cleaned so that the solder can flow easily on the connections.

(xi) Again check the regulator connections by keeping test lamp in series with the regulator terminals.

(xii) Connect the regulator with a ceiling fan.

(xiii) Mount it on a board.

(xiv) Cover the regulator with its cover.

(xv) Put the operating knob of the switch in position and tight it with screw.

(xvi) Make connection with the main supply.

(xvii) Operate the regulator to observe the working of the fan.

PRECAUTIONS

(i) While soldering the terminals, hold the wire with the help of flat nosepliersso that the heat of soldering iron may not destroy insulation of connection wires.

(ii) Connect fan regulator always in series.

(iii) Maintain air circulation in the regulator.

APPLICATION

Regulator is used as a voltage divider. Fan regulator is used to control the speed of a fan.

Activity No. 27 **Time Required: 10 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING TABLE FAN

OBJECTIVES

(i) To connect a table fan with main supply.
(ii) To dismantle and assemble a table fan.
(iii) To acquaint the students with different types of table fans.
(iv) To identify different parts of a fan.

RELATED INFORMATION

Generally we find different types of table fan in the market. The size of the table fan measures from its sweep (blade size):

(a) Table fan 22 cms, 30 cms, 35 cms, etc.
(b) All purpose table fan: The motor of this fan differ from other table fan's motor. It is a shaded pole motor without capacitor.
(c) A table fan having stand is called a pedestal fan.

Table fans are used to circulate air in their vicinity. Table fans (a) and (c) are generally a capacitor start single phase induction motor. The blades of the fans are mounted on the rotating shaft.

Since the table fan is within easy approach of everyone, the blades are enclosed with a cage to avoid accident. The cage is mounted on the outer front part of the body.

In a table fan, the motor is at the top of the body and the regulator is at the base. Regulator is used to decrease or increase the speed of the fan. The circulation of air depends upon the speed of the fan. Power consumption of a table fan is approximately 60 watts.

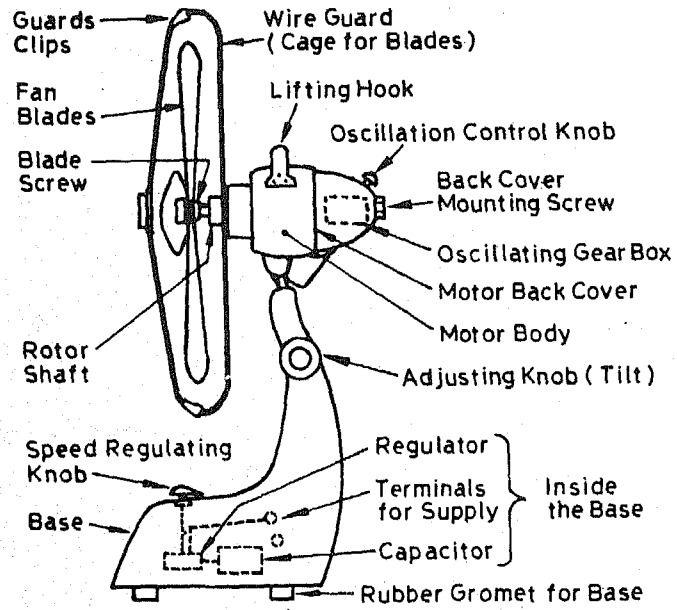


Fig. 27.1 Parts of a Table Fan.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Tools Required

(i) Insulated combination pliers 20 cm : one

(ii) Insulated screw driver (connector) : one

(iii) Insulated screw driver 15 cm : one

(iv) Insulated screw driver 25 cm : one

(v) Knife 15 cm : one

Materials Required

(i) Table fan : one

(ii) Duster (Piece of cloth) : one

(iii) Mobile oil/spindle oil with can : one

(iv) Grease for gear box

(v) Kerosene oil

(vi) Rubber mat : one

Equipment

(i) Multimeter (AVO) : one

PROCEDURE

(i) Collect required materials

(ii) Place the rubber mat on the floor/working table

(iii) Observe the fan's fittings.

(iv) Open the clips of the cage.

(v) Unscrew the blades mounting screws and remove the blades from shaft.

(vi) Unscrew the back cover and remove it.

(vii) Take out the gear box by removing the mounting screws of the box.

(viii) Remove the back cover of the motor by unscrewing the screw.

(ix) Take out rotor.

(x) Clean the shaft and bushes with the help of cloth and kerosene oil.

(xi) Clean the motor winding but do not damage the winding coils.

(xii) Apply mobile oil in the bush pad mountings and bushes.

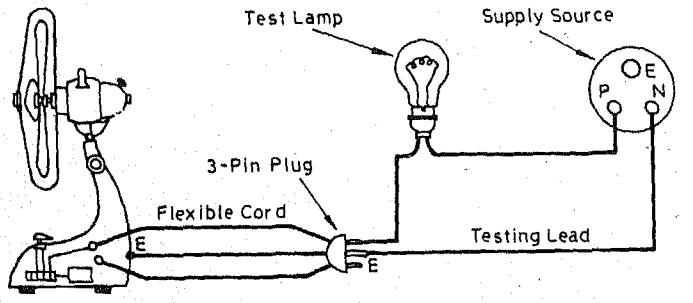


Fig. 27.2 Testing of Earth and Leakage between Conductor and Body of the Table Fan.

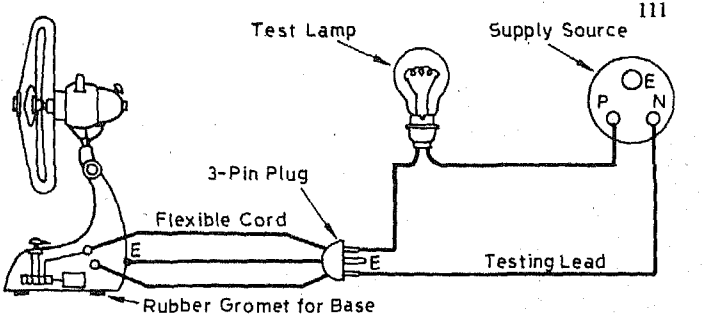


Fig. 27.3 Testing of Continuity, Short and Open Circuit Test between Main Conductors of the Table Fan.

(xiii) Put grease inside the gear box and clean it.

(xiv) Fit all the parts simultaneously.

(xv) Rotate the shaft and check it for proper fitting.

(xvi) After fitting, clean the fan with dustor cloth.

(xvii) Conduct earth and leakage tests of the fan.

(xviii) Conduct open circuit, short circuit and continuity tests.

(xix) Connect the fan to supply and check its working.

PRECAUTIONS

(i) Do not damage coils by hammering or cutting.

(ii) Do not hammer any part of the fan.

(iii) Before dismantling mark sign on the covers of the fan to maintain alignment for assembling.

Activity No.28 **Time Required: 10 Hours**

DISMANTLING TESTING AND RE-ASSEMBLING SMALL EXHAUST FAN

OBJECTIVES

(i) To dismantle an exhaust fan and to identify its parts.
(ii) To conduct test for faulty winding.
(iii) To re-assemble exhaust fan.

REALATED INFORMATION

Generally we find different types of exhaust fans in the market. All the exhaust fans are capacitor start single phase miduction motor. The speed of an exhaust fan is more in comparison with a ceiling or table fan. The size of an exhaust fan is measured from the size of its blades. Exhaust fans are available in sizes of 30 cms, 35 cms, 40 cms, 45 cms and 50 cms. They are used to exhaust dusty/smoky/suffocated air from room/building. They are also used in desert room cooler.

MATERIALS REQUIRED:

(i) Exhaust fan 230 V, 80 W : one
(ii) Duster cloth : one piece
(iii) Grease for bearing
(iv) Kerosene oil

TOOLS REQUIRED

(i) Insulated combination pliers 20 cm : one
(ii) Insulated screw driver 15 cm : one
(iii) Insulated screw driver 25 cm : one
(iv) Electrician knife 15 cm : one

(v) Ball pein hammer 450 gms : one
(vi) Cold chisel 15 mm : one
(vii) Test lamp 100 watt, 230 volt : one
(viii) Paint Brush 40 mm : one

PROCEDURE

(i) Observe the fitting and parts of the exhaust fan as shown in Figs. 28-1 and 28-2.

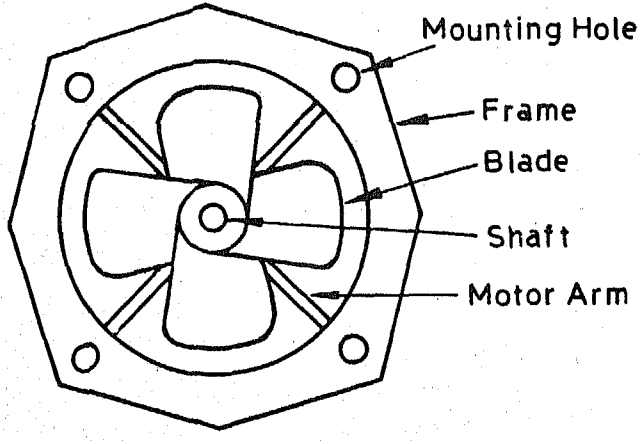


Fig.28.1 Front View of an Exhaust Fan.

(ii) Clean it with a piece of cloth or paint brush.
(iii) Unscrew the screws of the blades.
(iv) Remove the blades from the shaft.
(v) Mark sign on the body and on both rear and front

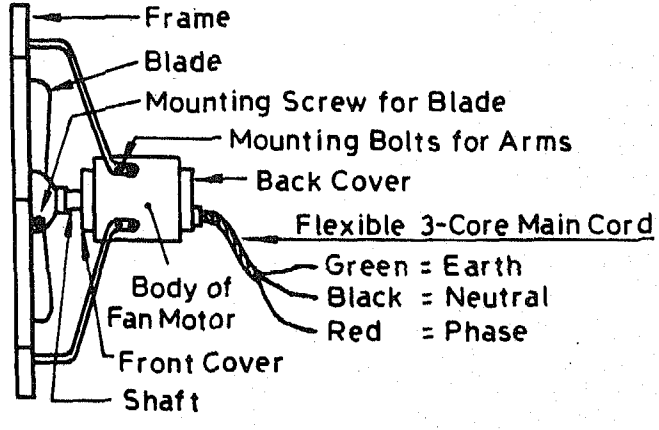


Fig. 28.2 Side View of an Exhaust Fan.

cover in one line.
(vi) Remove the back cover.
(vii) Check the connections of the condensor and the winding at the terminal plate.

(viii) Remove front cover.
(ix) Take out rotor from the body and stator.
(x) Remove bearing from both sides of rotor shaft.
(xi) Clean bearing with kerosene oil and brush.
(xii) Check the bearing. Bearing should be free from play.
(xiii) Fit the bearing into shaft.
(xiv) Apply grease in the bearing.
(xv) Fit the rotor into the body and stator.
(xvi) Cover the front cover and tight it with screws.
(xvii) Conduct continuity test, short circuit test and open circuit test with the help of series test lamp. Connect the series test lamp as shown in Fig. 28.3.
(xviii) After connections observe the light of series test lamp. If lamp glows dimly, it means the exhaust fan is alright
(xix) Conduct earth and leakage tests. Connect series test lamp as shown in Fig. 28.4. If lamp does not glow , it means that the exhaust fan is alright.
(xx) Fit the rear cover. Check the shaft of the fan by rotating it manually. The shaft should move freely.

PRECAUTIONS

(i) Check loose connections.

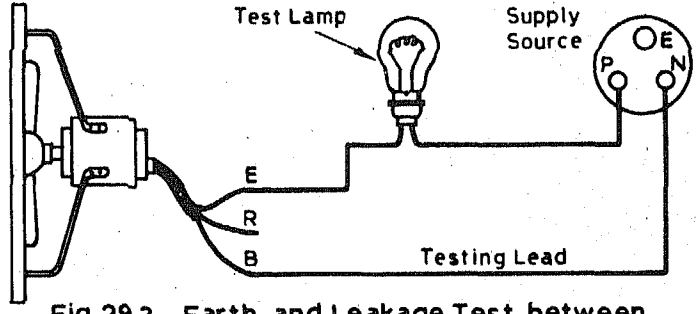


Fig.28.3 Earth and Leakage Test between Conductors and Earth (Body).

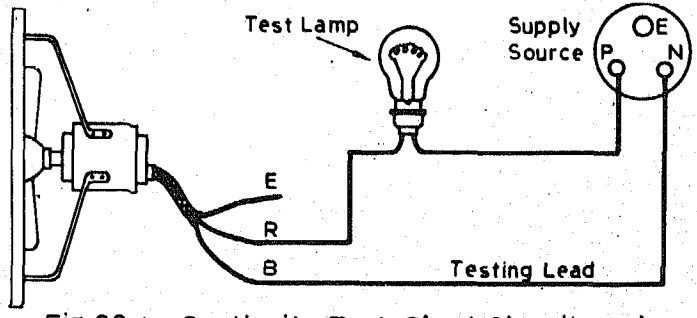


Fig.28.4 Continuity Test, Short Circuit and Open Circuit Test between Conductors.

(ii) The blades should be tightly fixed on the shaft of the fan.

(iii) Before connecting the tan to the main, check its mounting bolts.

Activity No.29 **Time Required: 5 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING FAN HEATER

OBJECTIVES

(i) To dismantle an electric fan heater and to identify its different parts.
(ii) To conduct tests for fault finding.
(iii) To reassemble an electric fan heater.

RELATED INFORMATION

The function of a fan heater is to heat the air space in the room or area in which it is placed. The housing of this heater consists of a heating element and a small fan to blow out heat given by the element. The control switch has four positions, OFF,I,II and F. At position F only the fan will work. At position I, fan and one element will work. At position II, fan and two elements will work.

The motor is a single phase 220 volts shaded pole motor. The capacity of the heating element is 1000 W, 1500 W, 2000 W and 3000 W.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Material required

(i) Fan heater 1000 w, 230 v. : one
(ii) Duster cloth : one piece
(iii) Brush 20 mm : one
(iv) Kerosene oil
(v) Mobile oil with can
(vi) Empire sleeve

Tools Required

(i) Insulated combination pliers 20 cm : one

(ii) Insulated screw driver (connector) : one
(iii) Insulated screw driver 15 cm : one
(iv) Insulated screw driver 25 cm : one
(v) Electrician knife : one
(vi) Series test lamp 100 watt : one

EQUIPMENT REQUIRED

(i) AVO (Multimeter) : one

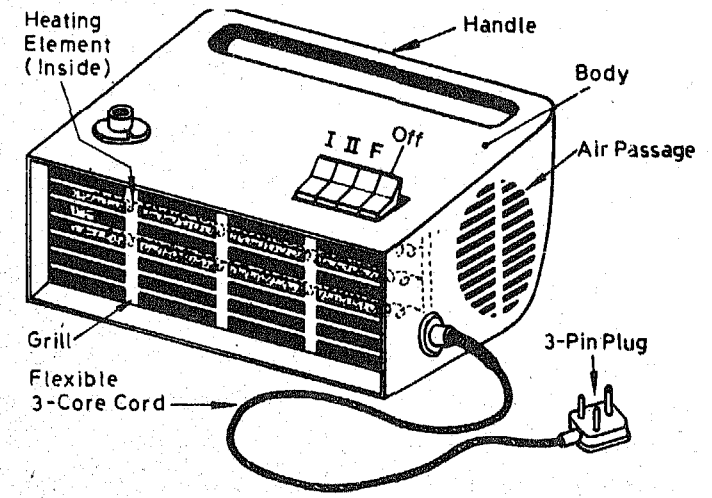


Fig.29.1 Air Heater / Heat Convector.

PROCEDURE

(i) Procure tools, materials and equipment.
(ii) Observe the fitting of the fan heater and its parts as shown in Fig 29.1.
(iii) Clean it with a duster cloth.
(iv) Check three-pin plug top and its main cord.
(v) The top cover and both the side cover are mostly in one piece. Unscrew the side screws and remove the top cover.
(vi) Check the heating element. Tight screw if there is any loose connection. Insulate bare conductor with empire sleeve or empire tape.
(vii) Remove the motor from the body.
(viii) Dismantle the motor and clean it with a duster cloth or paint brush.
(ix) Clean the shaft and bush with kerosene oil.
(x) Apply mobile oil to bush pad.
(xi) Assemble the motor and mount it on the body of the heater.
(xii) Conduct continuity test with the help of a series test lamp as shown in Fig 29.2. After connecting the lamp observe the light of the test lamp. Press the

switch F,I,II and OFF. Lamp gives little dim light in case of II switch, more dim light in case of I switch and very dim light in case of F switch, no light in case of OFF. This means fan heater switch is alright.

(xiii) Cover the heater with top cover.

(xiv) Conduct earth and leakage test. Connect the series

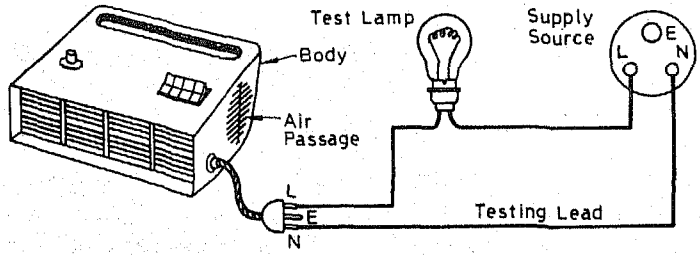


Fig.29.2 Continuity, Short, Open Circuit Test between Conductors.

test lamp as shown in Fig.29.3. After connecting the series test lamp, observe the light of the lamp. If lamp does not give any light, it means the apparatus is free from earth and leakage fault.

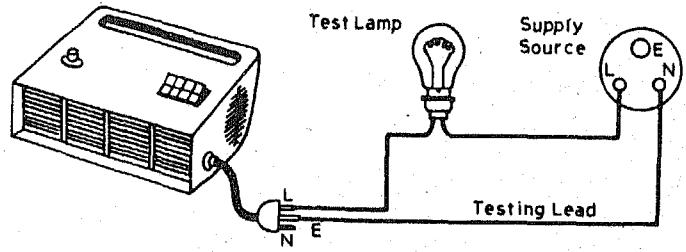


Fig.29.3 Earth and Leakage Test between Conductors and Earth (Body).

PRECAUTIONS

(i) For insulation inside the heater only empire sleeve or empire tape should be used. No P.V.C. tape should be used.

(ii) For main flexible cord only rubber insulation cord should be used.

(iii) Do not put your finger or any other thing inside it while in use.

(iv) Avoid loose connection.

Activity No.30 **Time Required: 6 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING HAIR DRYER

OBJECTIVES

(i) To dismantle an electric hair dryer.
(ii) To identify different parts.
(iii) To develop skills for fault finding.
(iv) To reassemble the hair dryer.

RELATED INFORMATION

This is a very handy equipment for drying hair. Hair dryer consists of a small fan and a heating element. The air from the fan blows over the heating element and becomes hot. A two-pin plug top is connected at the end of the cord whereas the other end is connected to the hair dryer. The heater element and the fan are housed in an unbreakable bakelite body. The fan motor used in the hair dryer is a

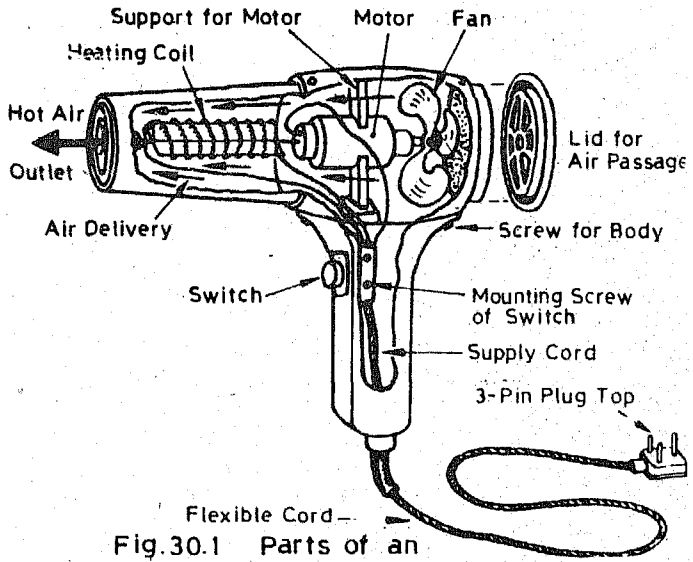


Fig.30.1 Parts of an Electric Hair Dryer

shaded pole motor which operates on 220 volts.

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Materials Required

(i) Hair dryer : one
(ii) Duster cloth : one piece
(iii) Paint brush 15mm : one
(iv) Spindle oil with can
(v) Kerosene oil

TOOLS REQUIRED

(i) Insulated screw driver connector : one
(ii) Insulated screw driver 15 cm : one
(iii) Insulated four headed (Philips) screw driver 15 cm one
(iv) Insulated combination pliers 20 cm : one
(v) Insulated flat nose pliers 15 cm : one
(vi) Knife 15 cm : one

EQUIPMENT REQUIRED

(i) AVO Meter : one.

PROCEDURE

(i) Procure material and tools.
(ii) Observe fitting of the dryer.
(iii) Unscrew screws of the body.
(iv) Lift cover of the body.
(v) Check heating element and switch.
(vi) Remove motor from the assembly.
(vii) Check the motor.
(viii) Clean bush and shaft of the motor with kerosene oil.
(ix) Apply oil in the bush pad.
(x) Fit motor and tight screws.

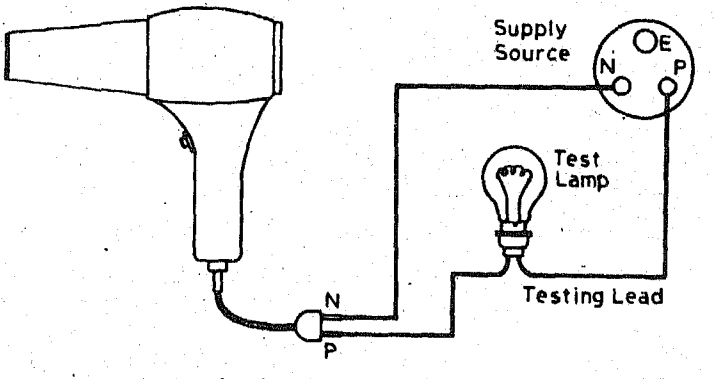


Fig.30.2 Continuity Test, Short Circuit Test and Open Circuit Test between Conductors.

(xi) Tight top cover of the hair dryer.

(xii) Conduct continuity test, short circuit test and open circuit test of the motor and heating element.

PRECAUTION

Do not put any metalic part or finger into the mouth of the dryer when it is working.

Activity No. 31 **Time Required: 10 Hours**

DISMANTLING, TESTING AND RE-ASSEMBLING MIXER

OBJECTIVES

(i) To dismantle a mixer
(ii) To identify different parts of a mixer
(iii) To conduct tests for finding faults of a mixer
(iv) To reassemble a mixer

RELATED INFORMATION

Electric mixer is a boon for housewives. It is a very useful appliance for grinding spices, onions, garlic and ginger etc. Another use of this mixer is in preparation of fruit juice, milk shakes, etc.

The speed of the mixer is very high. The mixers are available in small, medium and large sizes. The large size is mostly used for commercial purposes.

The electric mixer can be divided into three parts from construction point of view.

BASE: The base portion houses an electric universal motor with a ON/OFF Switch or a selector switch if it is a multi-speed motor.

Grinder and Blender: The grinder is of two types. The one is for fruit juice, vegetable juice, etc.It is called blender. For grinding dry and hard spices, the blades of the grinder are small in size and are made of hard stainless steel.

Bowl: The material to be grinded or mixed is put into the bowl. After the preparation is ready, the bowl along with the grinder is detached from the shaft of the motor. The contents are then poured out.

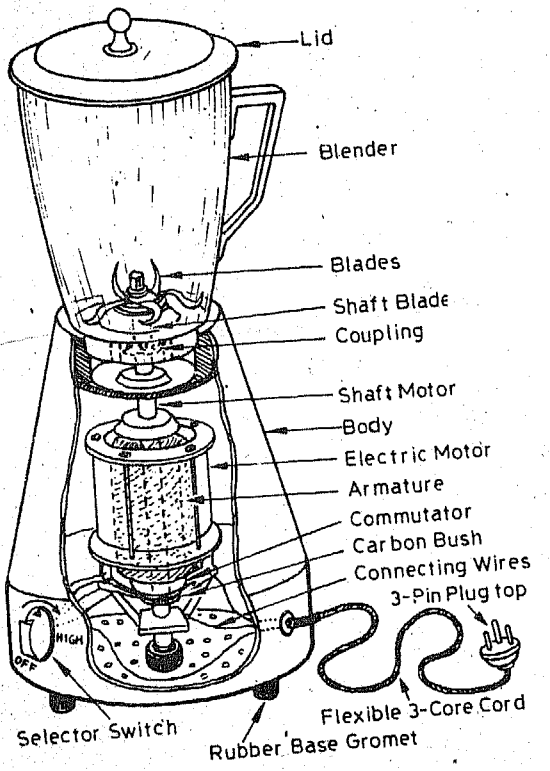


Fig.31.1 Parts of an Electric Mixer.

The bowl and grinding blades are coupled with the help of a nylon coupling (having radial fins over its periphery).

TOOLS, EQUIPMENT AND MATERIALS REQUIRED

Tools Required

(i)	Insulated combination pliers20 cm	: one
(ii)	Insulated screw driver 15 cm	: one
(iii)	Insulated screw driver 25 cm	: one
(iv)	Knife 15 cm	: one
(v)	Test lamp 100 Watt, 230 Volt	: one

Materials Required

(i)	Mixer	. one
(ii)	Duster (piece of cloth)	: one
(iii)	Mobile oil/spindle oil with can	
(iv)	Kerosene oil	
(v)	Sand paper	

PROCEDURE

(i) Observe fitting of the mixer carefully.

(ii) Remove blender from the mixer.

(iii) Unscrew base cover screws and remove the base cover.

(iv) Remove nylon coupling from the shaft.

(v) Unscrew motor mounting screws.

(vi) Remove the motor from the body.

(vii) Dismantle the mixer.

(viii) Check bushes.

(ix) Clean shaft and bushes with kerosene oil.

(x) Apply mobile on bushes and shaft.

(xi) Connect test lamp in series with the motor as shown in Fig. 31.2 for continuity test, short circuit test and open circuit test.

(xii) If the lamp glows with switch on, it indicates that the motor is alright.

(xiii) Connect a test lamp in series with the motor as shown in Fig. 31.3 for earth and leakage test.

(xiv) With the mixer switch on, if the light glows, it indicates that the motor is free from leakage and earth fault.

(xv) Align carbon bush and its holders properly.

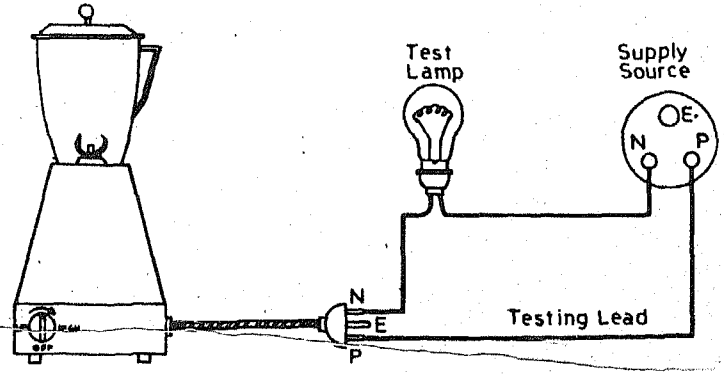


Fig.31.2 Continuity, Short Circuit, Open Circuit Test between Conductors.

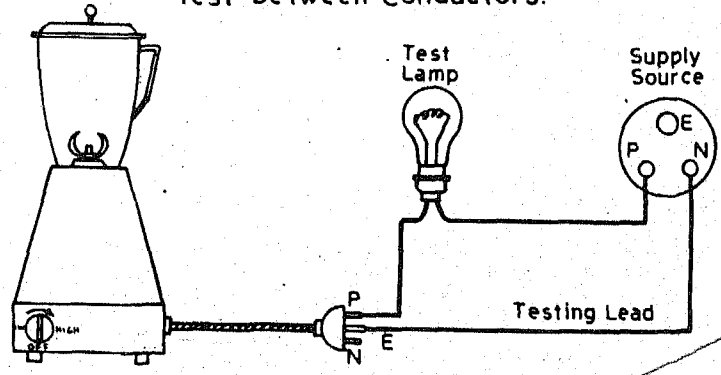


Fig.31.3 Earth and Leakage Test between Conductors and Earth (Body)

PRECAUTIONS

(i) The mixer must not be kept "ON" for more than two minutes for any single operation.

(ii) Mixer bowl should be cleaned with water after every use.

(iii) No water should get into motor winding.

(iv) Do not put your fingers in the bowl when the mixer is in operation.